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ANNALS
OF
SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

EDITED BY
LEWIS STEPHEN PILCHER, M.D., LL.D.,
OF NEW YORK.

WITH THE COLLABORATION OF

J. WILLIAM WHITE, M.D., LL.D.,
OF PHILADELPHIA,
Professor of Surgery in the University
of Pennsylvania.

SIR WILLIAM MACEWEN, M.D., LL.D.,
OF GLASGOW,
Professor of Surgery in the University
of Glasgow.

SIR W. WATSON CHEYNE, BART., C.B., F.R.S.,
OF LONDON,
Professor of Surgery in King's College.

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ANNALS OF SURGERY

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ORIGINAL MEMOIRS.

THE AMERICAN SURGICAL ASSOCIATION. ITS INFLUENCE ON THE GROWTH AND DEVELOPMENT OF AMERICAN SURGERY.*

BY CHARLES A. POWERS, M.D.,

OF DENVER,

Professor of Clinical Surgery in the University of Colorado.

THE American Surgical Association has now completed thirty-three years of active life, and in selecting a subject for a Presidential Address before it I have thought it not improper to consider some features in the history of this body, a history which has been at all times highly creditable and of which we may well feel more than proud, together with some of the conditions which have attended the recent development of American surgery and the place which our school occupies in the modern surgical world. My treatment of this subject will necessarily be more or less discursive. I am fully cognizant of my own shortcomings in the matter of accomplished work but I have been a close student of surgical conditions in our country for thirty years and I have an unbounded pride in the splendid achievements of my fellow countrymen.

Our Association has exerted a profound influence upon the growth and development of American surgery: we as individuals owe it more than we perhaps realize. I know that our distinguished Fellow, Dr. Mears, an original member, has made this the subject of interesting and instructive contributions, but I have felt that the impressions of one who entered the ranks during the mid-period of the Association's life might prove of supplemental value.

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* Presidential Address Delivered before the American Surgical Association, Washington, May 6, 1913.

[NOTE.—For obvious reasons details regarding business matters pertaining to the affairs of the Association are omitted here.—C. A. P.]

The beginning of our Association was simple and dignified. The project had its inception in the mind of that master surgeon, Dr. Samuel D. Gross, who confided details of his plan to a few of his friends at the meeting of the American Medical Association held at Atlanta, Ga., in May, 1879. It was agreed that on the following day, immediately after the adjournment of the surgical section of the Association, he should, in a brief speech, lay the plans agreed upon before that body. This having been done, the meeting was organized by the appointment of the eminent and venerable Dr. L. A. Dugas, of Augusta, Professor of Surgery in the Medical College of Georgia, as Chairman and Dr. William W. Dawson, of Cincinnati, Professor of Surgery in the Medical College of Ohio, as Secretary. Brief addresses were made by different gentlemen, all cordially approving of the objects of the meeting. It being apparent, however, that the kind of an organization desired could not be then effected, nothing further was done on that occasion. Before separating Dr. Gross and his associates decided that a circular should be sent to the principal surgeons of the United States, setting forth their plans and inviting co-operation at a conference to be held in New York during May or June, 1880.

Organization was perfected at this next meeting which was held in the lecture room of the college of Physicians and Surgeons, Twenty-third Street and Fourth Avenue, New York City, on May 31, 1880, forty-eight gentlemen signing the constitution and thus becoming Fellows[1] of the Society.

Dr. Gross was made President and Dr. Weist, of Richmond, Ind., Secretary. A Constitution and By-Laws were temporarily adopted. The next meeting was held in Richmond, Va., May 5, 1881, nineteen Fellows being present. No scientific papers were presented. The meeting of 1881 was held at Coney Island, New York, September 13, 14, and 15. Eleven Fellows were present and five surgical theses were read and discussed. Dr. Gross was re-elected President.

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[1] Of these forty-eight gentlemen but three, Drs. Keen, Mears and Marks, are now living.

The meeting of 1882 was held in the hall of the College of Physicians, Philadelphia, on the last day of May and the first two days of June. Twenty-five Fellows registered and fifty gentlemen, from various parts of the country, were elected to active fellowship. Fear had been expressed that the Association would affect the strength of the American Medical Association. This was vigorously denied by Dr. Gross,[2] who said: "We can hurt no Society now in existence, or likely to come into existence. We can hurt only ourselves if we fail to do our duty. We hope to make the American Surgical Association an altar upon which we may annually lay our contributions to science, and so show to the world that we are earnest and zealous laborers in the interest of human progress and human suffering." Dr. Gross claimed that the American Medical Association would be strengthened by the new organization. That his prediction came true is realized by all of us who attend the splendid meetings of the Section on Surgery of that body.

At this meeting of 1882 four scientific papers were read and discussed, a large portion of the time of meeting being occupied in perfecting organization. Although he vigorously protested, Dr. Gross was again elected to the Presidency.

The meeting of 1883 was held in Cincinnati, forty Fellows signing the register. The Association urged its venerable President to accept a re-election, but this he steadfastly declined and the eminent Dr. E. M. Moore of Rochester, New York, was made his successor. Before adjourning the following resolution was unanimously adopted: "Resolved, That a vote of thanks be returned to our retiring President, Samuel D. Gross, and that the members of the Association unite in the hope that he may long be spared to meet with us, to cheer us by his presence and to guide us by his wise counsels."

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[2] Dr. Gross had been the Chairman of the Section on Surgery of the American Medical Association in 1867, 1870 and 1873.

The fifth annual meeting was held at Washington, April 30, May 1, 2 and 3, 1884, forty-three Fellows being present. The venerable founder was absent on account of illness, his paper on "Wounds of the Intestines" being read by Dr. T. G. Richardson. On motion, the following telegram was ordered sent:

Professor SAMUEL D. GROSS, Philadelphia.

The American Surgical Association has listened with pleasure and profit to your paper, regrets your absence, and sends the sympathy of all of its Fellows and their hope for your speedy recovery.

Edward M. Moore,
President.

Important papers were read and discussed, and on the fourth day of the meeting the following additional telegram was ordered sent:

Prof. S. D. GROSS, Philadelphia.

The Fellows of the American Surgical Association are unwilling to depart until they are able to learn whether their hope for the improvement of your health has been realized.

This hope was not to be made real, for three days later the great surgeon entered upon his long rest. His own hope had, however, been realized; the American Surgical Association which he had founded and sustained had lived and grown and become an honor to him.

It is not possible for one to study the volumes of the Transactions or the book of Minutes without feeling that the broad and lofty spirit of the Founder and his colleagues pervaded all that was done. Thus, in the presidential address of the meeting of 1885 the eminent Dr. William T. Briggs, of Nashville, said: "We may safely indulge the confident expectation that this meeting will be characterized by the spirit in which the Association had its origin, and will be pervaded by the same united purpose, the same harmonious and agreeable intercourse and similar valuable work to that which has edified and instructed us in previous meetings, and which, in the brief period of its existence, has so illustrated the usefulness of the Association, that its permanency as an exponent of the status of American Surgery, and as a factor in the true advancement of its science and art, is fully assured."

At this meeting of 1885 the first of the foreign Honorary Fellows were elected. These were: Paget, Lister, Erichsen, Annandale, von Volkmann, von Nussbaum, von Esmarch, von Czerny, von Billroth, von Langenbeck, Ollier, and Verneuil. Of these twelve distinguished European surgeons but one, von Czerny, survives.

At the meeting of 1886 Dr. C. H. Mastin, of Mobile, proposed the union of nine of the special associations under the title of, "The Congress of American Physicians and Surgeons," and in due course of time, and largely through the patient labor of Dr. Mastin, this Congress was formed, practically under the organization which governs it to-day. No comment need be made regarding its success; once in three years we all meet, at this suitable season of the year and in this beautiful city of Washington, and I feel sure that it is both interesting and instructive for the members of the various Societies to renew old acquaintance and profit by the reports of the advances which are being made in the various departments of Medicine other than those in which they are most actively engaged.

At the meeting of 1891 a Committee on the Address of the President, Dr. Mastin, recommended: "That the President be empowered to appoint a committee with authority to confer with the friends and admirers of the late Professor S. D. Gross, and with the profession at large, for the initiation of a movement on the part of the Association, having for its object the erection of a monument to Dr. Gross, in the City of Washington." A Committee of twenty-six of the Fellows under the Chairmanship of Dr. J. R. Weist, of Richmond, Ind., who had earnestly and ably served the Association as Secretary since its foundation, was appointed to forward this project. Their labors were successful, and in 1897 the dignified statue of our Founder, suitably placed in the city in which we are now meeting, was unveiled with appropriate ceremonies.

Allusion has already been made [3] to the important meeting of the International Surgical Society which will be held during the early part of the coming year in the City of New York. We are not to forget that the original suggestion for the formation of such a Society had its inception in the mind of our esteemed Fellow, Dr. Keen, who set forth a definite design at the meeting of our Association in 1895. Although fruition did not attend this particular plan the seed which he sowed fell on good ground, and I think it quite safe to say that it indirectly resulted in the formation of the dignified international surgical body which held its first meeting in the City of Brussels in 1905.

It would be trite to dwell on the advances which have been made and which are being made in Surgery. The progress has been as constant as it has been efficient. The scholarly Cheever in his address before this body in 1889, discussing the future of surgery, gave under the heading of operations as yet *sub judice,* or on trial: Resection of the pylorus; resection of cancerous intestine, of omentum; removal of the spleen; of large bronchoceles; of the larynx; the pancreas; the prostate gland; the normal ovary; fixation of the kidney, of the uterus; puncture of the pericardium; opening gangrenous abscesses in the lungs; tapping the ventricles of the brain. It need not be said that with the exception of the removal of the normal ovary all of these are ordinary procedures of to-day and that to these fields very many others have been added. "By the work one knows the workman"; I have already said that I feel unbounded pride in the work of the American surgeons who have gone before us, or who are now, as Seniors, resting from their labors, and of those still in, and approaching, their most productive period. It has been well said that: "The achievements of its citizens are the most valuable assets of a country"; it is in a spirit far from boasting that I say that my fellow-members of this Association have contributed constantly and effectively to the splendid progress which has placed modern surgery among the brilliant phenomena which characterize the last quarter of a century. This sentiment, to which I give expression, is a part of myself, and the thought leads me to ask, in a tentative way, whether we have not at this time and in this country a distinctive school of surgery? Definite answer to this must be made by our colleagues in other lands, and yet, as one views and reviews the leading clinics of the United States and of Canada he feels that there are certain marked characteristics which leave their impress on the mind of the impartial observer. Can these impressions be expressed in words? Not easily, yet an attempt may be made.

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[3] See previous note regarding the omission of certain details relating to the business of the Association.

One marked characteristic of our surgery would be, perhaps, a very broad spirit of catholicity and eclecticism. From the earliest days our surgeons have traveled, have studied, have gathered and brought back and placed in practice the best which they have found in other countries.[4] This has not been mere imitation, it has been intelligent selection. Further, our students and teachers have constantly added to the fruits which they have gathered abroad. The surgery of the brain and spinal cord, of the thyroid gland, of the breast, of the abdomen—especially the regions of the appendix vermiformis, of the gall-bladder, of the stomach, of the duodenum, of the large intestine—gunshot wounds of the abdomen, the surgery of the urinary bladder, of the prostate gland, of the cardiovascular system, of the joints, to mention but a few especial regions, all bear eloquent testimony to their labors. Again, they have made a practice of journeying constantly, for surgical study and observation, in this country. The meetings of the Society of Clinical Surgery form an admirable example of this, and we have, throughout the land, centres of clinical study to which our surgeons go more and more frequently. Further, this excellent habit of study-travel affects the surgeons in the smaller towns, greatly to the advantage of both teacher and student, using the latter word in the sense that all thinking men remain students.

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[4] It is not possible to in any way give adequate expression to the feeling of debt which we owe to the surgeons of other lands.

When we look over the list of surgical text-books published in this country we find reflected in no small degree the work and influence of the Fellows of this Association. Further, the books themselves will, I believe, bear favorably a comparison with those of other lands; their number and importance increase rapidly from year to year. Again, our surgical journals may well give us cause for pride.

In considering other salient features of our professional work I venture the thought that no men in surgery surpass ours in innate consideration for the best interests of the individual patient. Witness the care with which cases for operation are selected, witness the attention given to such important matters as anæsthesia, witness the desire for excellence in end results, witness all that makes for evenness in surgical work. The training and development of our nursing force in surgery has been no small factor in placing our surgical work where we find it to-day. Our training schools of nurses justly command the admiration of the surgical world.

Surgery with us attracts the very best of young men; young men of high ideals, of noble purposes; diligent, earnest seekers of the truth. It affords these young men abundant problems for solution, and our laboratories and wards bear testimony to the efforts which they are making. Many of these accomplished young men leave the metropolitan centres in which they have received their preliminary training and go out into the smaller cities and towns, there to develop hospitals in which much reliable work is accomplished. But I cannot refrain, at this time, from again calling attention to the absolute necessity for thorough preparation and training in surgery. Dr. Richardson made this the subject of a forceful address in 1907, an address well worth reading and re-reading, while Dr. Finney has recently emphasized the prevalence and danger of irresponsible surgery while address-ing the Southern Surgical and Gynæcological Association. Not every man who is practising surgery to-day is worthy of the name of surgeon. Experience is still a good teacher despite the fact that aseptic technic renders many ill-considered operations comparatively safe as regards the life of the individual. There is no royal road to surgery, and the long years of apprenticeship which our predecessors underwent and which we went through are as necessary at this time as in their day and ours. It is a long step from the mere operator to the real surgeon. The pseudo-surgeon is rife in our land as in others, and he is responsible in no small degree for the growing tendency toward commercialization in surgery, that hideous monster against which our faces are so sternly set.

But I must not allow myself to digress from the central thought of my theme, pride in American Surgery, for the good so immeasurably outweighs the bad. Never was surgery so well taught in our medical schools as to-day, never were the medical schools themselves progressing so rapidly toward higher and better standards. Never before has surgical research work been carried on with such earnestness and thoroughness. Cheever, in 1889, in the scholarly address to which reference has been made, took as his thesis " The Future of Surgery Without Limit "; the same subject might well be chosen to-day and one might well make the forecast that the fields which are *sub judice,* or on trial, at this time, will have been conquered at the end of another quarter of a century. In the coming years, as in the past, American Surgeons will bear well their part, and the Fellows of this Association will carry high the banners left in trust by Samuel D. Gross and his colleagues.

This, then, is my *professio fidei:* A deep reverence for the traditions of our craft and for the traditions of this Association; a profound regard and admiration for the surgical work which has been done and which is being done in our country, and a clear and steadfast confidence in all which our surgical future may have in store.

FIBROMATOSIS OF THE STOMACH AND ITS RELATIONSHIPS TO ULCER AND TO CANCER.*

BY ALEXIS THOMSON, M.D.,
OF EDINBURGH.
Professor of Surgery in the University of Edinburgh.

AND

JAMES M. GRAHAM, M.D.
From the Surgical Department, University of Edinburgh.

We propose in this paper to give a general account of the condition known as fibromatosis of the stomach, for it is the lesion which is most often mistaken for cancer.

We have chosen the term "fibromatosis" because it expresses the most striking feature of the lesion without conveying any view as to its nature or etiology. From the fact that we always found it associated with ulcer, "ulcer-fibromatosis" would probably be a more accurate term.

Although the condition has been known for the greater part of a century, there has always been, and there are still, the most widely divergent views as to its nature. Cruveilhier felt sure of his ground, for his paper, published in 1835, was entitled "Innocent Hypertrophy of the Pylorus." English authors, notably Brinton, who described the condition under the term "cirrhosis of the stomach" or "linitis plastica," and Handfield Jones, who employed the term "fibroid induration of the stomach," had also no doubt, it would appear, of the innocent nature of the affection. With the advent of more accurate methods of histological examination, in which German pathologists played a prominent part, there arose a confident and apparently unanimous opinion that Cruveilhier's innocent hypertrophy and Brinton's cirrhosis represented an atypical form of carcinoma.

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* Read before the American Surgical Association, May 6, 1913.

We have been fortunate in acquiring a number of specimens in a good state of preservation, chiefly derived from our own clinic, but largely augmented from those of our colleagues, and we are specially indebted to Professor Caird for generously placing a number of the specimens from his collection at our disposal. Our material consists of the following specimens almost exclusively obtained from the operating theatre: Fibromatosis, 9; fibromatosis with ulcer—cancer, 5; tuberculosis with cancer, 1; cancer—specimens specially selected for examination, 35.

We do not mean to imply, because our investigations have been carried out on a larger scale than was available to those who have preceded us in this inquiry, that we have reached anything like finality on the subject, but we claim to have made a number of reliable observations. We use the word reliable with confidence, because in the examination of the more difficult specimens, we have had the advise of two expert pathologists, Dr. James Ritchie, Superintendent of the Laboratory of the Royal College of Physicians, and Mr. Richard Muir of the Pathological Department of the University of Edinburgh.[1]

We believe that we are in a position to clear up, in some measure, the long-standing controversy as to whether fibromatosis of the stomach is innocent or malignant. We have found that in some cases it is innocent, while in others it is associated with cancer. The controversy owes its origin to the fact that there occurs in the stomach a diffuse infiltrating form of scirrhus cancer which in its distribution resembles fibromatosis, while at the same time it differs so much in its naked-eye and microscopic appearances from the classical forms of gastric carcinoma that its true character is not capable of being established without a thorough histological examination. The controversy has also been kept alive by the fact that when cancer involves a stomach that is already the seat of fibromatosis, the evidence of its presence in the stomach is not always easy to find, whereas it is readily discovered in the associated lymph glands.

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[1] We are also indebted to Mr. Pirie Watson, M.B. and Mr. R. C. Alexander, M.B., Assistants in the Surgical Department, and to Mr. Frank Pettigrew, technical assistant in the same department, for many of the illustrations.

Our material was prepared as follows: the resected portion of the stomach was fixed in Jeré's fluid, and after being embedded in paraffin, complete sections were cut, stained for the most part in hæmatoxylin and eosin, and mounted for examination under a low power of magnification. These large sections enabled us to study the distribution of the disease and the gross changes in the different coats of the stomach at different levels. Small portions of tissue selected from different parts of the specimen were cut and stained for examination with higher powers, in order to observe the nature of the cellular elements and the minute changes in the tissues.

Fibromatosis of the Stomach.—The condition may be limited to a portion of the stomach, the localized form, or it may extend throughout the entire stomach, the diffuse form. The localized form is not only the more frequent, but it is the form which, from the clinical point of view, is the most important to differentiate from cancer.

The Localized Form of Gastric Fibromatosis.—It nearly always commences in the vicinity of the pylorus and spreads from there toward the cardia, usually, but not always, showing a preference for the lesser curvature.

External Appearances.—There is a sharp contrast between the affected pyloric portion and the rest of the stomach; the latter is flaccid and collapses readily, whereas the affected portion is rigid, densely hard like gristle; the peritoneal surface, when free from adhesions, is white, pearly, and smooth. While this external appearance resembles cancer, it may be said that fibromatosis forms a flattened, smooth-surfaced tumor, whereas a cancerous tumor tends to be more rounded in shape, and is often nodular on the surface; this distinction, however, is so general that it cannot be depended upon. There is an absence of the cicatricial contraction that is so common a sequel of uncomplicated chronic ulcer, and there is no suggestion of cicatricial stenosis of the pylorus or of hour-glass contraction of the body of the stomach.

The glands along the curvatures, especially the lesser, are usually enlarged and firmer than normal, again suggesting cancer, but there is a greater tendency for them to retain their normal shape than is usual when they are infected with malignant disease. It goes without saying that we are not here considering advanced cases of malignant disease in which the appearance of the stomach and of the adjacent parts render the nature of the condition unmistakable.

Reference should be made to those cases of fibromatosis in which, when the abdomen is opened, the pyloric end of the stomach is found to be so buried in adhesion, matting it to the surrounding organs and to the omenta, and it may be also to the parietal peritoneum, that a satisfactory examination of the stomach is impossible; we believe that these represent the type of case in which either nothing can be done in the way of a curative operation, or at the most a palliative gastro-enterostomy or jejunostomy, and the patient, in spite of a gloomy prognosis, makes an unexpected and permanent recovery.

Changes in the Coats and in the Interior of the Stomach.—The pyloric portion of the stomach is converted into a rigid, funnel-shaped tube, the lumen of which is greatly contracted. The increase in the thickness of its wall is remarkable; in some of our specimens it measures 2.5 cms.

In the majority of the specimens we have examined (7 out of 9), there is situated, in about the centre of the affected area, a deeply-punched-out ulcer; the surrounding mucosa, instead of being as soft as velvet, freely movable on the subjacent coats, and showing prominent rugæ, is firm and unyielding, is closely adherent to the submucosa, and presents a hillocky surface, corresponding to variations in thickness of the fibromatosis in the submucous coat. The altered appearance of the interior stops abruptly at the pyloric ring, while toward the cardia it gradually merges into the normal, in other words, there is no ridge at its margin. In one case the appearances are especially characteristic; there is a large, deep ulcer occupying the greater curvature about three inches from the pyloric ring; in the area of the ulcer all the coats have disappeared, its floor being formed by a layer of dense scar tissue, while over the fibromatosis in the submucosa which extends round the remainder of the circumference, the mucosa is adherent and undulating, and appears thicker than normal. In two of our specimens, there is no visible punched-out ulcer, but the mucosa, over the submucous fibromatosis, presents a smooth, atrophied appearance, which microscopical examination shows to be due to a superficial form of ulceration combined with fibrosis. The undulating, hillocky appearance of the interior of the stomach is sometimes exaggerated so that there are eminences separated by deep clefts; the mucosa then presents a polypoidal appearance, and we think that it is probable that some of the specimens described in the literature and in museum catalogues as " polyposis of the stomach " may be examples of fibromatosis of the submucous coat, in which the contraction of the newly-formed fibrous tissue has caused the mucosa to project in the shape of polypoidal masses into the interior of the stomach.

The Presence of Ulcers and of Ulceration.—We devoted special attention to the condition of the mucosa of the stomach as we early suspected that a breach of surface of the mucosa would prove to be an antecedent of fibromatosis. We should like to restrict the term " ulcer " to the well-known punched-out defect in the coats of the stomach, easily seen with the naked-eye, and employ the term " ulceration or erosion " when the mucosa looks thin and wasted, and microscopical examination shows a partial disappearance of the glandular elements on the free surface, associated with chronic inflammatory changes in the interstitial tissue.

In nine specimens of fibromatosis limited to the pyloric end of the stomach, no less than seven showed a visible punched-out ulcer, situated, roughly speaking, in the centre of the affected area; in the remaining two specimens there was superficial ulceration over the greater part of the affected area. In the majority of cases, the punched-out ulcer had spread through all the coats of the stomach.

The Submucosa.—From being a thin, loose layer of areolar tissue supporting the larger blood-vessels and allowing the mucosa to move freely on the muscularis, it is converted into a thick, solid, tough white tissue, not so dense as keloid but resembling the consistence of a hard fibroma. It varies in thickness from .2 cm. to 1.2 cm. in different specimens and in different parts of the same specimen; in some cases it constituted ⅞ of the entire thickness of the gastric wall. On the cardiac side the fibromatosis tapers off gradually; on the pyloric side, it stops abruptly, usually at the pyloro-duodenal junction.

There is no difficulty in differentiating the fibromatosis from the scar tissue which frequently accompanies chronic ulcer, for, unlike scar tissue, it is uniformly distributed throughout the submucous coat, whereas, when the coats of the stomach are replaced by scar tissue, all traces of the original arrangement is lost.

The Muscularis.—The muscularis is very commonly the seat of a *marked hypertrophy of the circular fibres,* this being a response to the increased strain upon the organ in forcing its contents through the narrowed pylorus. In the rare cases in which the pylorus is not involved by the fibromatosis, this hypertrophy is absent. Hypertrophy of the circular fibres is usually sufficiently marked to be easily seen with the naked eye. The hypertrophy of the muscle is most marked near the pylorus, and tails off gradually toward the cardia.

More characteristic, however, than the hypertrophy, is the *segmentation of the circular muscle,* which is divided up into bundles by partitions or septa of white fibrous tissue continuous with the fibrillated tissue of the submucosa. The brown color of the muscle renders this segmentation very obvious to the eye. Hypertrophy of the circular muscular coat is a common accompaniment of cancerous obstruction at the pylorus, and it may be quite as marked as in the stenosis due to fibromatosis, but, so far as we know, it never shows the same degree of segmentation, and we have therefore come to regard it as a characteristic feature of fibromatosis. There is rarely any change in the longitudinal bundles of muscle.

The *subserous and serous coats* are little altered as a rule, but in some cases, they also are invaded by the fibromatosis and become correspondingly thickened.

The Pylorus.—Narrowing of the pylorus is almost a constant accompaniment of fibromatosis, and it may reach an extreme degree. It is chiefly due to the increase in thickness of the submucous coat, but it is also contributed to by the contraction of this coat whereby the mucous membrane is projected into the lumen, often in the form of folds or polypoidal eminences. The function of the pylorus as a channel of exit for the gastric contents is further impaired by the unyielding character of the tissue forming its wall.

When the fibromatosis extends to the pyloro-duodenal junction, and this is looked at from the duodenal side, the mucosa is seen to project as a collar-like ridge, and the pyloric aperture is reduced to a narrow slit, which presents variations according to the distribution of the lesion. As in the hypertrophic stenosis of infants, this appearance has been likened to that of the os uteri, but the comparison is less apt in the case of fibromatosis, as the opening rarely occupies the centre of the channel.

Microscopical Appearances.—Those necessarily vary at different stages of the process.

Histological Changes in the Mucosa.—Reference has been made already to the invariable presence of a visible ulcer or of ulceration in the mucous membrane. We shall here describe the changes seen with the microscope. Many of the specimens show increase in thickness of the mucosa, this sometimes amounting to three times the normal thickness. Some of this thickening appears to be due to contraction of the submucous coat, crowding the mucosa into a smaller area, but it is chiefly due to actual increase in the amount of the interstitial tissue. In some specimens this interstitial change is very pronounced, a thick layer of chronic inflammatory tissue elements separating the secreting tubules from the muscularis mucosæ. More frequently the new tissue separates the tubules from each other, compressing them and causing their gradual disappearance. In the progressive replacement of the tubules by young fibrous tissue there are appearances which might at first sight be mistaken for cancer; an attenuated tubule without a lumen may appear on transverse section like an alveolus filled with cancer cells, but further examination shows the continuity of the tubule with one opening on the surface and, further, that all the epithelial elements are superficial to the muscularis mucosæ. Some tubules show cystic dilation, others show remarkable elongation. Although there is no evidence of active mitosis or of proliferation of the epithelial cells, these changes might reasonably be regarded as precancerous in nature.

The muscularis mucosæ is in some cases involved in the fibrosis, that is, the muscle fibres are separated by young fibrous tissue.

The cellular infiltration, which is the main cause of the thickness of the mucosa, is composed mainly of small lymphocytes and plasma cells, with, in addition, a large number of proliferated endothelial cells and fibroblasts in an early stage of development. Some large phagocytic mononucleated cells are also present. There are no polymorpholeucocytes.

These chronic inflammatory changes in the mucosa are associated with ulceration on the free surface and loss of the covering columnar epithelium. It is noteworthy that this superficial ulceration is less in evidence in these specimens in which there is a visible punched-out ulcer; in the case already referred to on page 14, in which there is a large, chronic ulcer at the greater curvature, and a submucous fibromatosis in the remainder of the circumference of the stomach, the over-lying mucous membrane is intact. We feel warranted in making the inference from this observation that the changes seen in the mucosa in other specimens are primary in character. Were they secondary to, and a result of, the submucous fibromatosis, they would have occurred in this specimen. Our view is that the changes in the mucosa, particularly the ulceration, are primary, and are followed by the fibromatosis in the submucosa.

Histological Changes in the Submucosa.—In the fully-developed condition, the submucosa is represented by a thick, uniform layer of fibrillated connective tissue. The fibres are not arranged on a fixed plan as in a tendon, but, although in parts parallel, they mostly run in all directions as they do in a fibroma or in other forms of fibromatosis, *e.g.,* neuro-fibromatosis.

The connective tissue cells are scanty and are flattened between the fibres. Here and there are collections of lymphocytes in the vicinity of the muscularis mucosæ. There are numerous well-formed blood-vessels, presumably belonging to the original submucosa, and in addition there are a number of capillaries, more than was to be expected in view of the bloodless condition of the tissue as seen with the naked eye. There is a complete absence of endarteritis.

We are unable to confirm the observation that the fibrous elements of the submucosa undergo hyaline degeneration.

The scar tissue associated with ulcer, in contrast to fibromatosis, takes on more of the hæmatoxylin stain, the fibres do not present any regularity in their arrangement, the connective tissue cells are more numerous, and the tissue elements in the fully evolved condition, both fibres and cells, are more closely packed and are less vascular.

Histological Changes in the Muscularis.—The changes observed in the muscle are mainly those of hypertrophy. In the early stages of fibromatosis, separation of the muscle bundles is confined to the inner layers of the circular coat. In well marked cases the fibromatosis extends throughout the circular coat and may also affect the longitudinal coat although never to the same degree. The condition might be described as a coarse cirrhosis in which the muscle bundles are separated by fibromatosis which is continuous with and of the same character as that in the submucosa. At the same time small fasciculi and even individual muscle fibres are occasionally seen in the midst of the fibromatosis. The muscle fibres show no signs of degeneration; they appear capable of functioning and the only change observed is an increase in the number and in the length of the nuclei.

Cases of Fibromatosis Associated with Ulcer-cancer.—The combination of ulcer-cancer with fibromatosis is especially difficult to identify without detailed microscopical examination. In one of Mr. Caird's specimens the chronic ulcer is situated 6 cm. from the pyloric ring; on either side of it, the coats of the stomach are invaded and in parts replaced by an actively growing spheroidal-celled cancer, while beyond the limits of the ulcer there is a well-marked fibromatosis of the submucous coat with hypertrophy and segmentation of the muscularis.

In one of our own cases there is superficial ulceration of nearly two-thirds of the circumference of the pyloric segment of the stomach; in the remainder, the mucosa is irregularly thickened, and at one point, only to be seen with the microscope, there is the earliest visible stage of the invasion of the submucous and muscular coats, by a spheroidal-celled cancer. The fibromatosis is moderate in degree and its distribution closely corresponds to the ulcerated area in the mucosa. In another of our cases there is a punched-out ulcer about one inch from the pyloric ring, the floor of which consists of a mass of scar tissue replacing all the coats. At the edge of the ulcer, the scar tissue is being invaded by an extensive growth of cancer—a condition which is not appreciated by the naked eye—while beyond this there is a comparatively limited amount of fibromatosis.

In a fourth case there is an ulcer close to the pyloric ring, with marked fibromatosis both in the submucous and subserous coats, and an early adenocarcinoma proceeding from the edge of the ulcer and invading the submucous and muscular coats.

In the fifth case, for which we are indebted to Mr. Cathcart, there is in the centre of the fibromatosed area a deeply punched-out ulcer, which has eaten through all the coats; we failed to find evidence of cancer in the different portions of stomach submitted to microscopical examination, but this was readily found in an enlarged lymph gland, embedded in the fat of the lesser omentum.

The comment on this series of cases is that they all illustrate the same sequence of events. Following upon a chronic ulcer, attended with fibromatosis, there occurs an epithelial growth at the margin of the ulcer, and an invasion of the deeper coats of the stomach. It should be emphasized that, excepting the first of the five, there was nothing in the naked-eye appearance to suggest the presence of cancer.

Pathogenesis of Gastric Fibromatosis.—Gastric fibromatosis, in view of its selective and spreading characters, suggests an analogy with the fibromatosis of nerves—neurofibromatosis—but the analogy goes no further; we have examined the stomach from a case of generalized neurofibromatosis in our own collection, and we find that the submucosa is not appreciably altered and that the fibromatosis mainly involves the nerves of the muscular and subserous coats.

We have not observed any features that would suggest the view advanced by some writers that the lesion is of syphilitic origin; there is no characteristic granulation tissue and there is an entire absence of endarteritis, and in the cases in which we have had an opportunity of employing the Wassermann reaction, the results have been negative. We do not mean to deny the occurrence of a gummatous lesion of the pyloric portion of the stomach, causing stenosis of the outlet, such as has been described by Bird of Melbourne (B.M.J., Oct., 1910), but we have not met with the condition.

We are also disinclined to accept the view that fibromatosis is due to a tuberculous infection. We have had the opportunity of examining a specimen of Mr. Caird's which presents a combination of tuberculosis and cancer; the tuberculous granulation tissue, which shows typical giant-celled systems, is most abundant in the subserous coat. The suggestion that fibromatosis represents an attenuated form of tuberculous infection, in the sense propounded by Poncet and other members of the Lyons School, is not supported by our observations.

The most widely accepted view regarding the nature of the thickening in the submucous coat, which we have called a fibromatosis, is, that it is really a form of atrophic infiltrating scirrhous carcinoma. We would like to point out that we are familiar with this form of cancer in the stomach, and we recognize also that it may cause a diffuse thickening of the submucosa, which, to the naked eye, may be indistinguishable from the condition we call fibromatosis. The investigation of our material, in the light of this knowledge enables us to affirm most positively that fibromatosis may occur without the presence of cancer.

The Association of Fibromatosis with Ulcer or Ulceration of the Mucosa.—Having succeeded, as we believe, in establishing fibromatosis as an innocent affection of the stomach, we shall now consider the conditions under which it occurs. The most striking association is that which exists between fibromatosis and ulcer or ulceration of the mucosa.

The apparently invariable association of fibromatosis with ulcer or ulceration of the mucosa raises the question, is fibromatosis a primary change in the stomach or is it secondary to an antecedent lesion? We have never seen fibromatosis in a stomach that was otherwise normal. When fibromatosis is associated with a punched-out ulcer, the mucosa over the surrounding fibromatosis may be practically normal; this would appear to warrant the inference that submucous fibromatosis is not the cause of the changes in the overlying mucosa, but that these precede the fibromatosis and are probably related to it as cause and effect. In other words, the changes in the mucosa are primary and the submucous fibromatosis is secondary.

The lesion of the mucosa that is followed by fibromatosis is either a punched-out chronic ulcer or a chronic superficial ulceration; this naturally suggests that the necessary antecedent of fibromatosis is a breach of the surface, which permits of the access to the subjacent submucosa of a toxin or irritant, to which the tissue of the submucosa reacts, and the reaction takes the form of a diffuse, spreading, new formation of young fibrous tissue. The diffusion or spread of the fibromatosis in the submucosa, from its original seat of formation, its abrupt arrest at the pyloric ring, its extension mainly along the lesser curvature, its extension into the muscularis between the bundles of circularly disposed muscular fibres, all agree in supporting the view that the irritant which causes fibromatosis is conveyed from its entrance to the parts which react to it, by way of the lymphatics.

The capacity of spreading diffusely is one of the most suggestive features of fibromatosis, and is naturally one of the explanations of its having been regarded by many observers as an infective or malignant disease.

It is instructive to contrast fibromatosis with other forms of connective-tissue reactions resulting from irritants. It is obviously a form of "chronic inflammation," but it differs essentially from those which are familiarly known to us. Contrast it, for example, with the scar tissue in the fibre and margin of a chronic ulcer; scar tissue replaces the coats of the stomach, it shows no predilection for any one of them; it is confined to the immediate vicinity of the ulcer, and its naked-eye and microscopical appearances do not differ from those of scar tissue in any other tissue or organ of the body.

The same contrast holds good with the new formation of fibrous tissue, in response to irritation, seen, for example, in chronic lesions of the gall-bladder or of the urinary bladder. There may be great thickening and induration of the wall of either viscus, but there is no selective fibromatosis of any particular coat.

It is also instructive to contrast fibromatosis with the well-known forms of chronic interstitial fibrosis or cirrhosis which occur, for example, in the liver or kidney. In these, the new formation of fibrous tissue affects the whole connective tissue frame-work or stroma of the organ, and is diffuse from the outset, presumably because the irritant causing it is conveyed by the blood stream; in gastric fibromatosis, the new formation of fibrous tissue commences in the vicinity of a breach of surface in the mucosa, and selects the submucous coat, as if the irritant were slowly diffused along the lymphatics.

Considering the frequency of duodenal ulcer, it is remarkable that there is no record of fibromatosis similar to that met with in relation to gastric ulcer; this, together with the fact, that, duodenal ulcer is practically immune to the incidence of cancer, inclines us to conclude that there is some peculiarity in the pyloric portion of the stomach which renders it liable, both to ulcer-fibromatosis and to ulcer-cancer.

Relationships of Fibromatosis to Cancer.—We have sufficiently elaborated the proposition that fibromatosis is not cancer, and we believe we have proved that it may occur apart from cancer. There remains, however, the very important observation, that the ulcer which is complicated by fibromatosis may also become the starting point of cancer, and we have been able to record the details of five cases which illustrate this combination of lesions. Our observations suggest, that the ulcer is the primary lesion, that the ulcer is followed by fibromatosis, and that, finally, a cancer orginates at the edge of the ulcer. The epithelial proliferation, being walled in by the dense scar tissue around the ulcer, and by the scarcely less dense fibromatosis in the surrounding submucosa, is greatly hindered and makes little headway, so little that it is difficult to recognize it except on careful microscopical examination. Cancer cells escape into the lymphatics from time to time and, when they have reached the adjacent lymph glands, are identified in these more easily than in the primary focus.

The type of cancer is either an adenocarcinoma or a spheroidal-celled cancer.

Clinical Features of Ulcer-Fibromatosis.—Inasmuch as fibromatosis is always a sequel of peptic ulcer or ulceration the clinical features are practically those of ulcer, and they are influenced to a greater degree by the seat of the ulcer than by its association with fibromatosis. In the exceptional cases, in which the pylorus is not involved the symptoms are inconclusive; indigestion and epigastric pain of some months duration, such as would not have suggested operative interference but for the recognition of a palpable tumor, which was diagnosed as cancer.

In the cases, in which the pylorus was involved, the symptoms were those of pyloric obstruction; and as in the majority there was an absence of free hydrochloric acid, along with a palpable tumor, the diagnosis of cancer was made with confidence. Hemorrhage was a prominent feature in only one case, although there was an ulcer or ulceration in all the cases. The discovery of a tumor in the epigastrium, sometimes made by the patient, occurred in a larger percentage of the cases than is usual in cases of ulcer uncomplicated by fibromatosis. The sexes were affected in approximately equal proportion.

The Recognition of the Nature of the Tumor When Exposed by Operation.—In the great majority of cases in which the abdomen is opened and a tumor of the pyloric segment of the stomach is rendered available for examination, it is possible to make a reliable diagnosis as to its nature. The clinical history, the tests of the gastric functions, and the radiographic appearances, together with what one can see and feel, will enable the operator to come to a decision as to the nature of the lesion. And yet, with all these data to go upon, the operator has been wrong in his decision in no less than nine of the cases recorded in this paper. It is easy, in the light of after events, to explain these diagnostic errors. The operator has been led to expect the existence of a pyloric carcinoma; on opening the abdomen, he finds a tumor involving the pylorus, obstructing the pyloric outlet, spreading along the lesser curvatures, and associated with enlargement of the lymph glands in the lesser omentum. He naturally regards the diagnosis of carcinoma as confirmed, and he proceeds to resect the stomach. Supposing, however, the operator has been deceived in previous cases and insists on immediate microscopical examination of a portion of the tumor or of one of the enlarged glands. The examination of one of the lymph glands is the most easily carried out and also, the most instructive. If it is found to show cancer, no further doubt is possible, but, and this is our point, if cancer is not found, the question is by no means solved. A positive result is conclusive, but a negative one is of little value. The more we have studied this question of immediate microscopical examination the less are we prepared to rely upon it. In several of our specimens we have been obliged to cut sections from different parts of the tumor and from several of the enlarged glands related to it, and instead of the few minutes implied in the term "immediate microscopical examination," prolonged and repeated efforts were required before the question of innocence or malignancy could be decided with any approach to certainty. The suggestion that a surgeon should delay the important steps of the operation until he has been informed of the results of the histological investigation conveys a confidence in rapid microscopical diagnosis which we regret we are unable to share.

Inspection of the interior of the stomach may help in a limited proportion of doubtful cases. A projecting cauliflower growth, for example, establishes the diagnosis of cancer; the absence of such a growth, however, does not exclude cancer. The discovery of a chronic ulcer, without infection of glands, would justify the operator in performing a limited resection instead of the radical operation for cancer.

Operative Treatment of Gastric Fibromatosis.—If we suppose that the condition has been correctly diagnosed and that the existence of cancer has been excluded, we advise that the affected portion of the stomach should be resected, because of the undoubted risk of cancer supervening.

Suppose, further, that it has not been possible to exclude the presence of cancer, and we believe that this is a more common condition of affairs, then again, we say resect. A reasonable alternative, and one we have ourselves practised, especially in weakly patients, is to perform a gastro-enterostomy and at the same time remove several of the enlarged glands from the lesser curvature. If these show the presence of cancer, the resection should be carried out after a suitable interval for recuperation. Further, if the disease, not diagnosed with certainty either as cancer or ulcer-fibromatosis, does not lend itself to radical operation, then relief to the symptoms should be afforded by gastro-enterostomy, and, if this is impracticable, by jejunostomy. Eiselsberg records a case of fibromatosis of the pyloric segment, treated by jejunostomy and the patient was in good health six years after the operation.

The Diffuse Form of Gastric Fibromatosis or "Leather-Bottle" Stomach.—In the classified work by Brinton on diseases of the stomach, it is taken for granted, that the diffuse form of the lesions, is, like the localized variety, innocent in character. We confess that at first we shared this opinion but we are now convinced of the unreliability of our observations owing to the imperfect preservation of the specimens of "leather-bottle" stomach in the University Museum. We have only been able to examine (and that owing to the kindness of Dr. Drennan) one first specimen of the lesion; sections taken from different parts of the stomach and from the glands, show a diffuse form of carcinoma.

We do not think the observations recorded up to now are sufficient to decide the question. We think it is probable that an innocent form of "leather-bottle" stomach does occur; we are not surprised, however, that it is rare, because the spread of the disease throughout the stomach affords ample time for the superaddition of cancer and because the patient is liable to succumb to the localized form of the disease before it has had time to become diffused, or he is relieved of it by the surgeon.

DIAGNOSIS AND TREATMENT OF FRACTURES INVOLVING THE KNEE-JOINT.

INCLUDING EPIPHYSEAL SEPARATION.

BY JOHN BAPST BLAKE, M.D.,

OF BOSTON, MASS.

Surgeon-in-Chief, The Boston City Hospital.

We have for consideration lesions affecting three bones,—the patella, the tibia and femur.

The patella.—*Number.*—In 1906, Dr. David Scannell published a valuable paper upon compound fracture of the patella,[1] which included a tabulation of all fractures in the Boston City Hospital in forty-two years. According to this tabulation there were during this period 38,627 fractures of all kinds, of which 660 were closed and 8 open (compound) fractures of the patella. A careful examination of the records from January, 1906, to May 1, 1913, reveals 211 simple and 3 open patella fractures in addition, so that from May 24, 1864, to January 1, 1913, there have been a total of 871 simple, and 11 open fractures of the patella treated at the Boston City Hospital.

Frequency.—Scannell compared his figures with those of Gurlt (Hamburg, 1862) who reported 51,938 fractures from London hospitals. This author found that fracture of patella constituted 1.27 per cent. of all fractures. Stimson, 1912, in 14,566 fractures at the Hudson Street Hospital, New York City, found 183 fractures of the patella, or 1.26 per cent. Scannell found the per cent. to be 1.9 per cent. and it is probable that the relative frequency of this fracture has slowly increased, so that it now forms distinctly more than 2 per cent.

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* Read before the American Surgical Association, May 6, 1913.

[1] Comp. fract. patella. Report of unusual case. Tabulation of all fractures in Boston City Hospital in 42 years. David D. Scannell, M.D., Boston Med. and Surg. Jour., Nov. 15, 1906.

of the fractures occurring in Boston, and presumably throughout the United States.

Etiology.—More and more has it become evident that the cause of this fracture is muscular, or indirect violence, in the large majority of cases. The fact that only 11 of 882 cases were open fractures argues strongly for this view, because it is highly improbable that if direct violence were the frequent cause, open fractures would be so rare (but little more than 1 per cent. of all patella fractures). The writer has been impressed by the fact that the amount of muscular violence required to fracture the patella may be apparently slight, and it may be part of some action habitually performed by a healthy man. For instance (personal knowledge), three cases have occurred in athletes in the customary preliminary effort of turning a somersault. A majority of patients, however, believe that the patella is broken by the direct violence of the fall, and only by careful questioning is the accurate history obtained.

Symptoms.—Muscular violence of course produces the transverse or tear fracture, with considerable separation of fragments; indirect violence results in the comminuted or multiple fracture, often with little, occasionally (if a strong prepatellar bursa remains intact) with no separation. In this latter class of cases mistakes may be made, since the typical signs, including crepitus, separation of fragments, loss of function, may be absent. One sign, however, is always present, an increase in the intra-articular fluid, either synovia or blood or both, obliterating the normal hollows or dimples of the joint. In any acute traumatic synovitis, therefore, fracture of patella should be suspected, and positively ruled out before establishing treatment and giving prognosis.

Treatment.—Of 418 cases treated since 1895, 245 have been operated upon and 173 treated expectantly. The percentages of cases subjected to operation grows rapidly in recent years: 13 cases were admitted from January 1 to May 1, 1913, and every one has been sutured. In the early years, drilling the fragments and wiring was the routine procedure. At present, though details vary with the large number of surgeons, suture with catgut or kangaroo is the rule. In the records of fifteen and twenty years ago there are frequent references to secondary operation for the removal of wire, though the results on the whole were very good; patients were kept in the hospital almost twice as long as at present; in 1895 and 1896 the duration of hospital treatment was from six to ten weeks, at present it is less than half as long.

Refracture.—Since 1895, only seven cases of refracture have been found in the records, and four of these are within the past year, the other being much earlier. Unquestionably the tendency to limit the stay in the hospital has diminished the enforced idleness of the patient, but undoubtedly the present tendency is to let the patients leave the hospital a little too early. A sutured patella will not stand a sudden strain four weeks after the operation and refracture will inevitably occur in a certain number of cases, if patients are discharged under conditions which favor carelessness and permit accident.

In one of the four recent refractures, the condition was open, though sustained seven weeks after the original operation. Precise conclusions as to liability of refracture in operated as compared with non-operated cases are not possible, since the number is too small, but the writer believes that the chance is about an even one, the operated cases being, perhaps, a trifle more liable to refracture. In a series of cases reported in England some years ago, the conclusion drawn was that bony union in fracture of the patella does not lessen the chance of refracture, and bony union occurs only as a result of operation, except in very rare instances.

Death.—It was a surprise to find that there were no less than six deaths due either to delirium tremens (4) or to pneumonia (2) in the series of 418 cases since 1895. Of these one died of pneumonia after operation; one of delirium tremens after operation (the writer's case). The four others were treated without operation; one died of pneumonia and three of delirium tremens. Still another patient developed severe and long-continued delirium tremens while in the hospital, but eventually recovered. There were two deaths from causes other than these, so that the total mortality was 8 in 418 cases, or nearly 2 per cent.

The writer's fatal case above mentioned was a middle-aged sailor noted to be nervous and tremulous at entrance. His condition improved, and seemed normal on the tenth day, when suture was performed. Immediately tremor returned and again disappeared, only to develop once more on the tenth day after operation. The wound was clean, the joint normal, and the skin sutures had been removed; he passed into stupor and died five days later. Autopsy was not permitted. This death is not to be attributed to the operation for fracture of the patella, but to a mistake in surgical judgment in instituting any surgical procedure of whatever nature. It is possible that the man would have died even without operation, as did the four others.

The writer, in common with many others, has passed through the period of drilling fragments, and using wire. Since the publication of Dr. Joseph Blake's paper in 1904, however, his classification and technic have been adopted and modified little if at all. The treatment is based upon the assumption that the condition is more a rupture of a tendon and a joint capsule than a fracture of a bone. In the writer's own series of some thirty cases, operation has been performed on the seventh to tenth day. Preliminary injection of the joint practised by Dr. Murphy has not been done, the tear in the lateral capsule is closed with interrupted sutures of No. 2 plain catgut, after all clots have been removed from the joint, using for this purpose instruments, not gauze; the torn periosteum is lifted from between the patellar fragments and sutured across the line of fracture, after a half purse string suture placed at either side of the patella has closely approximated the fragments; silkworm gut sutures close the skin tightly, and without drainage; a padded ham splint is applied, and the leg elevated; stitches removed from the skin on the tenth to twelfth day. At the end of two weeks gentle lateral motion of the patella is made; passive flexion of knee through a small arc in three weeks; gentle active motion of knee in four to five weeks; patient discharged in four to six weeks, to wear splint until eight weeks after the operation. It is expected that if these directions are carefully followed, the patient should be at work in or within three months, with a strong knee and from 60 to 90 degrees flexion.

In one case a much less satisfactory result is known to have followed operation, because the patient, a very nervous young woman, could not be made to bend her knee or use her leg; at three months she had less than 20 degrees flexion; she then accidentally struck the knee against a sharp object, and fearing refracture, again refused to use it. At length, after active massage was insisted upon and vigorously instituted, she began to gain and when last seen had about 50 degrees flexion and a useful leg. Such unwillingness to bend the knee, a not infrequent occurrence, is one of the most effective causes of inadequate results, and is not easy to overcome; it emphasizes the importance of careful treatment after the patient has left the wards, a thing not always easy to compel in the careless modern city dwellers.

Open Fractures.—Of the eleven cases since 1864, eight reported by Scannell and three since his publication, only four (Scannell 1, Blake 1) have been entirely without infection; two were slightly and superficially infected; three moderately, though not harmfully infected, and two seriously infected. One of the very early cases (1889) died of delirium tremens two weeks after operation (this is not included in the cases of death described above).

One of the writer's two cases of refracture was open; the patient celebrated his discharge by getting drunk, seven weeks after the original operation; he fell down stairs; was brought to the hospital with the wound torn wide open, the fragments separated at least three-quarters of an inch, and the joint full of blood clot and dirt. The skin was scrubbed and cleansed with excessive thoroughness, and the joint irrigated with gallons of hot salt solution, the capsule then closed as at the previous operation, and the skin sutured tightly. The convalescence was absolutely normal without the slightest rise of pulse or temperature. The result at the time of discharge from the hospital was as good as that of the closed fractures after operation, and this is true of the other open fractures in which there was little or no suppuration.

EPIPHYSEAL SEPARATION OF (*a*) FEMUR; (*b*) TIBIA.

(*a*) *Femur.*—Drs. Binney and Lund have just finished a careful and complete paper, based upon a study of all cases of separation of the lower epiphysis of the femur recorded in the Boston City Hospital since 1898. The paper is about to be published and the authors have kindly permitted me to summarize some of their findings.

Eighteen cases, from six to nineteen years of age, were admitted to the hospital since 1898. Of these, 13 were simple, and 5 open or compound; hyperextension was the cause in almost every instance, the exceptions being direct violence; 14 were injured in wagon accidents, no less than 7 having the leg caught in the spokes of the revolving wheel; the deformity varied from a very slight, to an extreme degree, in one case the diaphysis projecting four inches through the popliteal space. In 16 cases the epiphysis was moved forward, in two the displacement was lateral. In a majority of instances the reduction of deformity was easily accomplished under ether; in 6 cases the reduction was either difficult, or recurred, requiring repeated manipulations; in 2 cases, serious deformity persisted in spite of every effort; one case (open) came to amputation on account of interference with the circulation by pressure of lower end of diaphysis upon the vessels; one (open) was complicated by infection with gas bacillus, the leg being saved but with poor result owing to recurring forward displacement of the epiphysis. In one the recurring deformity was overcome by open operation and fixation with a wire nail driven through the external condyle into the epiphysis, with a perfect result. The method of maintaining position after reduction was (1) simple fixation on ham splint or in plaster; (2) fixation in moderate, occasionally in extreme, flexion. Operation (*a*) suture of periosteum; (*b*) fixation by nail.

Screws, plates, and mechanical devices are reported to have been used by others, but it is obvious that they should be avoided except as an absolutely last resort, and should always be removed as soon as union is firm. The results at the time of leaving the hospital were remarkably good, considering the severity of the conditions; position must of course be controlled by frequent X-rays; the knee-joint was, apparently, not permanently affected in any of the cases.

While examining the records I have found two additional cases of separation of the femoral epiphysis, in which the index diagnosis was misleading; one complicated a very severe fracture of the midshaft of femur, in a boy of twelve; in this instance the displacement was slight and the ultimate result good. The second was at first considered a fracture, but careful X-rays showed it to be a dislocated epiphysis, in front of femur. Three efforts at manual reduction were ineffective, and open operation was necessary. This makes a total of twenty of these cases.

(*b*) *Separation of Upper Epiphysis of Tibia.*—This condition, recognized and described as a separate entity, is found only twice in the City Hospital Records. It seemed inexplicable to the writer, until he was informed by Dr. James Stone, that not a single instance is recorded in the Records of the Boston Children's Hospital. Conversation with other surgeons lends authority to the statement that separation of this epiphysis is extremely rare indeed; apparently violence which might be expected to produce it, in reality acts upon the lower end of the femur and its epiphysis, the tibia remaining uninjured, unless a true fracture results. In the two cases treated at the City Hospital the displacement was slight, and fixation gave excellent results. While examining X-ray plates of the knee, the writer discovered two previously unrecognized cases of the condition first described by Osgood, of Boston, in 1903,[2] and now called the Osgood-Schlatter disease. It is a partial or complete separation of the tubercle of the tibia, occurring in youth. Osgood points out that while the upper tibial epiphysis includes in an anterior lip the tubercle of the tibia, the latter sometimes has a separate centre of ossification; the patella tendon inserts into this tubercle, though the tendon has accessory lateral bands going to the sides of tibia. The first pull of the powerful quadratus femoris muscle, however, is delivered upon the tubercle, and at times separates it completely, at times lifts the lower extremity partially away from the shaft. The two Boston City Hospital cases occurred in boys of 11 and 14 years and were said to be due to a fall or the effort to prevent a fall. There was local tenderness and the question of incipient bone disease, or of a fracture. The degree of separation was slight, but taken in connection with the history and symptoms, leaves little doubt of the character of the lesion. Rest and fixation are indicated, operation is very rarely needed, and results are good.

The records also contain four cases of epiphysitis of the head of the tibia, in which trauma apparently played a part. It is possible that a separation may have been the original condition in some of these. One suppurated, and was operated, but eventually died; a second was operated and recovered; the others recovered without operation.

(*c*) *Fracture of the Head of the Tibia into the Joint.*—This lesion is much more common than the separation of the corresponding epiphysis, but less common than a corresponding fracture of the lower end of the femur.

A recent law suit in Massachusetts called attention to the fact that this high fracture of the tibia may easily be overlooked by excellent general practitioners. In the case in question the injury, a fall from a step ladder, was treated as a severe contusion and sprain of the knee. Limitation of motion, together with continued swelling and tenderness of the joint, caused the patient after some weeks to go to a hospital, where the X-ray showed a fracture of the outer tuberosity of the tibia, united in fairly good position. Whether a better result could have been obtained if the diagnosis was correctly made in the beginning, is an open question. In the past year two cases have been admitted to the writer's service as rupture of the internal lateral ligaments of the knee, in both of which a fracture of the inner tuberosity could be determined by careful examination; crepitus was not obtained, but slight mobility and exquisite tenderness below the insertion of the lateral ligament made the diagnosis probable before confirmation by the X-ray. Just as the sprain-fracture at the ankle-joint is more frequent than was formerly supposed, so the rupture of the lateral knee ligament is very apt to carry with it a larger or smaller fragment of the head of the tibia. Repeated X-rays are necessary to rule out such a fracture in cases where it may be suspected.

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[2] Lesions of the tibial tubercle occurring during adolescence. Robert B. Osgood, M.D., Boston Med. and Surg. Jour., Jan. 29, 1903.

The question of massage and early motion are naturally influenced by such a condition, and the prognosis as to complete motion must be more guarded. As a rule reduction under ether, fixation, and appropriate padding will maintain good position, but it may occasionally be necessary to use a wire nail or to insert a plate; this is a less serious procedure than in the corresponding fractures of the femur, since a small plate might be inserted without necessarily invading the knee-joint. Dr. Lund succeeded in getting an excellent result by the use of a wire nail in a case of fracture of the internal condyle of the tibia with partial dislocation of the lower leg. Repeated attempts to maintain position of the broken tuberosity were unavailing, until the nail was inserted. The result was excellent.

A careful examination of the records of the last three years reveals eighteen cases of very high fracture of the tibia into the knee-joint. The eitology is in the majority of instances a fall striking at the point of fracture, though in one instance it was a crush between logs, and in another it is said to have occurred (together with a high fracture of the fibula) by a sudden twist resulting from an attempt to board a rapidly moving trolley car, a most unusual example of a torsion fracture. In about one-half the cases, the correct diagnosis was not made even in the hospital until X-ray plates were taken, and these at times revealed fractures of one or other tuberosities without displacement. One case had been considered by an excellent surgeon as a dislocated internal semilunar cartilage. In three of the eighteen cases one or more vertical median fissures existed, constituting fracture of both tuberosities; one case was open, with a triangular bit broken from the front of the tibia.

Marked synovitis is recorded only a few times, and the results at the time of discharge were unexpectedly good, though the arc of motion is not always given. The compound fracture suppurated and was repeatedly operated, leaving a knee with much diminished power of flexion.

Supracondyloid Fracture of Femur.—In the records from 1877 to 1891, twenty-seven cases are noted as "fracture of femur at knee." Of these one had a coincident fracture of the patella, one was a fracture of the external condyle, two of the internal condyle and one a T-fracture. One died on the day after entrance and a second after an amputation of the thigh. The others were discharged either "well," or "relieved." There were no X-rays in this series.

For the three years previous to 1913, there were admitted twenty cases in which fracture of the lower end of the femur invaded the knee-joint. Of these two were open; one of these had other injuries, and the patient was in profound shock, gas bacillus infection developed, followed by pneumonia, and the patient died on the fifth day. The second was in a child of four years, with very extensive lesions of the soft parts; sepsis developed, amputation was recommended and refused for three days; hip-joint amputation was finally done, but death occurred five days later. One case of simple fracture died in five days, but this was also complicated by other injuries.

The term supracondyloid fracture of femur is elastic.

As a rule it is used to mean fracture below the lower third of the shaft. It is often oblique, and a majority of oblique supracondyloid fractures involve the knee-joint, either directly, or through the subcruræus bursa. The deformity is almost invariably of lower fragment backward, and this is maintained by interposition of soft parts, and pull of calf muscles. In the vast majority of cases hyperextension, or the carrying forward of the extended leg, the thigh being fixed, will produce separation of the epiphysis in the young, and supracondyloid fracture in the adult.

In the twenty cases of this series, one only showed a forward displacement in an adult. There was a single case in a boy of eleven years, which gave every clinical symptom of a separated epiphysis; the X-ray, however, showed a fracture of the shaft a scant inch above the epiphysis with an angular (30 degrees) displacement forward from this point. This is the only case found in which history of accident, and clinical signs in a child, pointed directly to epiphyseal separation, and yet a fracture was demonstrated as the actual lesion. There was also one fracture three inches above the condyles in a boy, with lower fragment posterior, this being the only instance of the adult type of supracondyloid fracture in a child.

Treatment.—Five of the twenty cases were treated by open operation; once the lower fragment was pried into place, and remained in fair position; once it was wired, with a fair result; three times Lane's plates were used with moderately good results. The other cases were treated either by direct extension, or extension and the double inclined plane; in one the leg was held at right angles, for the first two weeks, as this seemed to keep the lower fragment from displacement.

The indications for operation have seemed to be, marked and persistent deformity, danger of weak union, and rotation of condyles by backward displacement of upper and of lower fragment, so that flexion of knee may be seriously limited. Men differ widely upon the degree of these elements which makes operation imperative: certain cases of extreme comminution of supracondyloid shaft, which refuse operation, obtain unexpectedly good results (one such case is at present in the wards); and at times operation does not accomplish what seems fair to expect. On the whole, open operation for supracondyloid fractures will probably be a little more frequent in the future than in the past. But, as in all other localities, non-operative methods should have most thorough and thoughtful consideration before being discarded.

The diagnosis rests ultimately upon the X-ray but may be made clinically more and more accurate by continued thought and care.

CONCLUSIONS.

First, the five principal traumatic bone lesions involving directly or indirectly the knee are influenced less than might be expected by the fact that they invade the largest joint in the body.

Second, trauma affecting the knee-joint, if sufficient to produce fracture, causes fracture of patella most frequently, of femur next in order, and of tibia least often; in patients under 20 years such trauma usually causes separation of the lower femoral epiphysis.

Third, with the exception of sepsis, the other complications added to fractures in this region are: *a.* Greater difficulty in maintaining position of fragments; *b.* greater limitation of motion after union has taken place; *c.* in certain operative cases, an added danger, that of invading a joint with a solid body.

Fourth, the indications for treatment are similar to those applicable to other fractures except that non-absorbable materials should not be used within the limits of the knee-joint unless it is absolutely unavoidable, and the immobilization be practised for a period longer than is advisable in fractures not involving joint cavities.

AN ANALYSIS AND STUDY OF 724 MAJOR AMPUTATIONS.

BY WILLIAM LAWRENCE ESTES, M.D.,

OF SOUTH BETHLEHEM, PA.

Director and Physician and Surgeon-in-Chief of St. Luke's Hospital, South Bethlehem, Pa.

In 1894 the writer published a paper entitled "A Contribution to the Study of Modern Amputations" (*Medical Record,* Nov. 3, 1894). This paper tabulated 340 major amputations performed at the writer's clinic in St. Luke's Hospital.

The present paper adds 384 major amputations, all taken from this clinic, and combines the two lists, thus presenting for study 724 major amputations.

The list published in 1894 is as follows:

Single Major Amputations.	No. of operations.	Deaths.	Mortality percentages.
Amputation of arm	27	1	3.70
Amputations of forearm	37	0	0
Amputations at shoulder-joint	13	1	7.69
Amputations of foot, Chopart's	7	0	0
Amputations of foot, Hay's	2	0	0
Amputation of foot, Pirogoff's	1	0	0
Amputations of foot, Syme's	9	0	0
Amputations of leg, lower third	47	1	2.12
Amputations of leg, middle third	28	0	0
Amputations of leg, upper third	22	1	4.50
Amputations of thigh, lower third	44	5	11.36
Amputations of thigh, middle third	25	2	8.00
Amputations of thigh, upper third	8	1	12.50
Amputations at knee-joint	17	1	5.88
Amputations at hip-joint	7	1	14.28
Total	294	14	4.76
Synchronous Double Major Operations.			
Amputation at the shoulder-joint, and the other arm, lower third	1	0	0
Amputation at shoulder-joint and the other arm, middle third	2	0	0

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* Read before the American Surgical Association, May 6, 1913.

Synchronous Double Major Operations.	No. of operations.	Deaths.	Mortality percentages.
Amputation at shoulder-joint, and the other forearm, middle third	1	0	0
Amputation at shoulder-joint, and a leg, lower third	1	0	0
Amputation at shoulder-joint, and operation for compound depressed fracture of the cranium.	1	0	0
Amputation of both arms	1	1	100
Amputation of arm, upper third, and leg, middle third	1	0	0
Amputation of arm, lower third, and forearm, middle third	1	0	0
Amputation of both forearms	1	0	0
Amputation of both feet, Chopart's	2	0	0
Amputation of both feet, Hay's	2	0	0
Amputation of one foot, Chopart's, and other leg, lower third	1	0	0
Amputation of one foot, Syme's, and other leg, lower third	2	0	0
Amputation of both legs	7	3	42.8
Amputation at knee-joint, and other leg, lower third	1	0	0
Amputation at knee-joint, and other leg, middle third	1	0	0
Amputation at knee-joint, and other thigh, lower third	1	1	100
Amputation of one leg, lower third, and exsection of the other ankle-joint	1	0	0
Amputation of one leg, lower third, and other thigh, lower third	2	2	100
Amputation of one leg, upper third, and other thigh, lower third	1	0	0
Amputation of one leg, middle third, and other thigh, lower third	2	1	50
Amputation of both thighs, lower third	2	0	0
Amputation of both thighs, middle third	1	1	100
Amputation of one thigh, middle third, and all the toes of the other foot	1	0	0
Amputation of one thigh, lower third, and operation for removing fragments and apposing and draining compound fracture of the other leg	1	0	0
Total	38	9	23.68

Synchronous Triple Amputations.			
Amputation of thigh, lower third, left arm, lower third, and half of right hand	1	0	0

Synchronous Triple Amputations.	No. of operations.	Deaths.	Mortality percentages.
Amputation of thigh, lower third, leg, middle third, arm, upper third	2	2	100
Total	3	2	66.6

Synchronous Triple Mixed Operations.			
Amputation of thigh, lower third, leg, lower third, and closing and draining extensive lacerations of the scalp	1	0	0
Amputation of thigh, lower third, arm, middle third, and closing and draining extensive laceration of scalp	1	1*	100
Amputation of left thigh, middle third, right foot, (Syme's), removal of fragments, apposition and draining of compound comminuted fracture of right humerus	1	0	0
Amputation of both thighs, middle third, and closing and draining extensive laceration of scalp	1	1	100
Total	4	2	50.00

Quadruple Mixed Operation.			
Amputation of thigh, lower third, leg, middle third, half of palm of the hand, and closing and draining extensive laceration of scalp and forearm	1	0	0
Total	1	0	0

The added list is as follows:

Single Major Amputations.	No. of operations.	Deaths.	Mortality percentages.
Amputation of arm	35	0	0
Amputation of elbow-joint	3	0	0
Amputation of forearm	19	0	0
Amputation of foot, Chopart's	8	0	0
Amputations of foot, Hay's	19	0	0
Amputations of foot, Pirogoff's	2	0	0
Amputations of foot, Syme's	11	0	0
Amputation of foot, Lisfranc	1	0	0
Amputations of foot, Mickulicz	2	0	0
Amputations at knee-joint	16	0	0
Amputations of leg, lower third	58	0	0
Amputations of leg, middle third	30	0	0

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* Died of cerebritis produced by the injury to head.

Single Major Amputations.	No. of operations.	Deaths.	Mortality percentages.
Amputations of leg, upper third	7	0	0
Amputations at shoulder-joint	23	1	4.34
Amputations of thigh, lower third	59	3	5.8
Amputations of thigh, middle third	19	5	26.31
Amputations of thigh, upper third	7	2	28.57
Amputations at hip-joint	3	3	100
Total	322	14	4.34

Synchronous Double Major Amputations.			
Amputation of right arm, lower third, and forearm, lower third	1	0	0
Amputation of arm, upper third, and leg, middle third	1	0	0
Amputation at shoulder-joint, and lower third of thigh	2	0	0
Amputation of both feet, Hay's	1	0	0
Amputation of right leg, lower third, and Syme's amputation of left foot	2	0	0
Amputation of both legs, one lower third, and other middle third	1	0	0
Amputation of right leg, middle third, and Syme's amputation left foot	2	0	0
Amputation of leg, lower third, and arm, upper third	1	0	0
Amputation of leg, middle third and arm, lower third	1	1	100
Amputation of both legs, middle third	2	0	0
Amputation of right leg, upper third, and left foot through the metatarsus	1	0	0
Amputation of both legs, one at the knee-joint, the other middle third	1	0	0
Amputations at both knee-joints	2	0	0
Amputation at knee-joint, and leg, lower third	1	0	0
Amputation of thigh, lower third, and portion of one hand	1	0	0
Amputation of thigh, lower third, and arm, lower third	2	0	0
Amputation of thigh, lower third, and leg, lower third	1	0	0
Amputation of thigh, lower third, and leg, middle third	3	0	0
Amputation of thigh, middle third, and leg, lower third	2	0	0
Amputation of thigh, middle third, and leg, middle third	1	0	0

Synchronous Double Major Amputations.	No. of operations.	Deaths.	Mortality percentages.
Amputation of both thighs, one middle third, and the other lower third	2	0	0
Amputation of both thighs, middle third	3	1	33 1/3
Amputation of thigh, upper third, and arm, upper third	1	1	100
Total	36	3	8.33
Synchronous Double Mixed Operations.			
Amputation of forearm, middle third, and operation for drainage and suturing laceration of leg	1	0	0
Amputation at shoulder-joint and operation for laceration of a leg and fracture of the femur.	1	0	0
Amputation at shoulder-joint, ligation of the subclavian vessels, and exsections of portions of the clavicle and the acromion process of scapula for crush of the upper extremity	5	1*	20
Amputation of foot (Hay's), and operation for compound comminuted depressed fracture of the cranium	1	0	0
Amputation of leg, middle third, and operation for compound comminuted fracture of humerus	1	0	0
Amputation of leg, middle third, and operation for drainage and relief of extensive contusion of the other leg	1	0	0
Amputation of leg, upper third, and operation for closure and drainage of extensive lacerations of hand, and compound fracture of metacarpal bone of the thumb	1	0	0
Amputation at knee-joint, right side, and operation for removing fragments, controlling hemorrhage and drainage for compound comminuted fracture of left femur	1	1	100
Amputation of thigh, lower third, and operation for extensive laceration of the foot on the other side	1	0	0
Amputation of thigh, lower third, and operation for compound depressed fracture of the skull	1	0	0
Amputation of thigh, lower third, and operation for removing fragments and drainage of crushed foot	1	0	0
Amputation of leg, lower third, and operation for exploration and drainage of extensive laceration of the perineum	1	0	0

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* Hopeless.

Synchronous Double Mixed Operations.	No. of operations.	Deaths.	Mortality percentages.
Amputation of thigh, middle third, and operation for drainage and suture of laceration of the other leg	1	0	0
Amputation of thigh, upper third, and wiring compound fracture of radius	1	1	100
Total	18	3	16.66

Synchronous Triple Amputations.			
Amputation at left shoulder-joint, middle third right thigh, and Chopart's amputation left foot.	1	0	0
Amputation of both thighs, middle third, and arm, upper third	1	0	0
Total	2	0	0

Synchronous Triple Mixed Amputation and Operations.			
Amputation of leg, lower third, thigh, lower third, and operation for compound comminuted depressed fracture of the cranium	1	0	0
Amputation of both forearms, middle third, and operation for compound fracture of leg and multiple lacerations of scalp	1	0	0
Amputation at knee-joint, left side, amputation of right foot, and operation for reduction of dislocation and fracture of femur	1	0	0
Amputation of thigh, lower third, leg, lower third, and reducing dislocation of hip-joint	1	0	0
Amputation of thigh, lower third, reduction of upward dislocation of hip-joint of other side, and suturing lacerations of leg	1	0	0
Amputation of one leg at knee-joint, plating femur on same side for fracture, and wiring compound fracture of the inferior maxilla	1	0	0
Total	6	0	0

The combined list is as follows:

Single Major Amputations.	No. of operations.	Deaths.	Mortality percentages.
Amputations of arm	62	1	1.61
Amputations of elbow-joint	3	0	0
Amputations of forearm	56	0	0
Amputations at shoulder-joint	36	2	5.55
Amputations of foot, Chopart's	15	0	0
Amputations of foot, Hay's	21	0	0

Single Major Amputations.	No. of operations.	Deaths.	Mortality percentages.
Amputation of foot, Lisfranc	1	0	0
Amputations of foot, Pirogoff's	3	0	0
Amputations of foot, Syme's	20	0	0
Amputations of foot, Mickulicz	2	0	0
Amputations of leg, lower third	105	1	0.95
Amputations of leg, middle third	58	0	0
Amputations of leg, upper third	29	1	3.78
Amputations of thigh, lower third	103	8	7.76
Amputations of thigh, middle third	44	7	15.9
Amputations of thigh, upper third	15	3	20.0
Amputations at knee-joint	33	1	3.03
Amputations at hip-joint	10	4	40.0
Total	616	28	4.54

This gives for study 616 single major amputations, 71 double amputations, 20 mixed operations; that is to say, a major amputation and at the same time another major operation done, but not an amputation.

In these mixed cases sometimes the secondary major operation was of greater magnitude and more exhausting than the amputation itself. There were 16 triple and 1 quadruple amputations.

About fifty of these amputations were done for pathologic conditions, 674 done for crushing injuries received on railroads, mines and factories.

Many of the cases were not received at the hospital until several hours after the injury and had to endure the exhaustion of long journeys as well as the shock of the injury and loss of blood. This fact should be borne in mind in noting the mortality rate.

This paper is intended to be a study based on the experience of a single clinic. All deductions, analyses and conclusions should be understood as representing the convictions of the chief of the clinic. They may be tinctured by personal predilections and may be erroneous. The statistics have been carefully compiled, however, and they as well as the recommendations are honest.

Conditions which Require the Amputation of an Extrem-

ity.—Pathologic conditions will not be considered at all, only conditions resulting from violence will be considered.

Evulsion of a limb, of course, admits of no question.

Annular crushes (that is to say, when all the tissues of a limb have been crushed through the whole of a limited transverse section of the limb), require amputation.

When the soft tissues under the skin as well as the bone have been comminuted by a squeeze or pressure of a car wheel or heavy machinery, even though the skin may not be badly lacerated, an amputation will be required.

If the bone or bones of a limb be comminuted beyond a distance of 6 cm. and the soft tissues immediately about the bone be badly lacerated, one should amputate.

Extensive longitudinal and oblique lacerations admit of conservative treatment as a rule, while circular ones are apt to require amputation.

Circular lacerations involving the chief blood-vessels and nerves as well as the muscles require amputations.

In estimating the condition of an injury the extensive muscular lacerations should receive less consideration than great injury to an extensive area of skin.

Compound fractures which sever a large nerve trunk do not require primary amputation, conservatism should always be tried. The nerve may be sutured and spliced if necessary.

Compound fractures with injury to one system of blood vessels when there are two, do not require primary amputations. When both systems of blood vessels are torn, amputation as a rule is necessary. Anastomoses of blood vessels at the site of a badly mangled limb, may, as a rule, not successfully be done.

When fractures are comminuted as well as compound, injuries to the soft tissues are much more extensive. Areas of thromboses will be much greater and conservatism be less successful.

In any given case while it is probable that conservative attempts may save a limb but leave it in a useless condition, or in a doubtful state, it would be best to amputate if the amputation would assure a useful stump, unless the injury be high up in the thigh where the mortality rate of amputation is high.

The individual and his trade or employment should always be taken into consideration in determining whether the probabilities should weight for or against an amputation.

Doubtful conservative attempts in cases of very seriously crushed limbs have a larger percentage of mortality than amputations have. This fact should also be taken into consideration.

In all cases of doubt, having carefully considered the foregoing facts, one should always delay the amputation. *Conservation is always the proper policy when there is a good chance for its success.*

The first sign of gas bacillus or streptococcal infection in these very doubtful delayed cases should determine an ampution immediately, and the open treatment of the stump afterward.

The Time for Amputation.—Sometimes it is very difficult to determine whether in a given case an immediate amputation after an injury should be done or not. There can be no doubt, in the writer's opinion, that the proper time for an amputation is as soon after the injury as the patient can safely be prepared for the operation, *if his condition will permit it.* Having, therefore, determined an amputation must be done, the surgeon should carefully examine the general condition of the patient.

A good blood pressure apparatus is an exceedingly useful instrument in making these determinations. Exhaustion from the severity of the injury (Crile's "noci associations" from nerve irritation), exhaustion from psychic shock (this is only temporary), exhaustion from loss of blood, exhaustion from the effects of a long journey to the hospital or to the surgeon, all contra-indicate immediate operations. The degree of exhaustion will be indicated by the blood pressure. In no case operate when the blood pressure is very low.

Psychic shock, by judicious handling of the patient and the free use of morphine, may soon be relieved and no delay may be necessary. The " noci associations " serve to produce low blood pressure for a longer time. This condition requires relief of nerve irritation by " blocking the nerves," with cocaine, or novocaine, then active heart stimulants. Short delays only are necessary in these cases.

Acute anæmia is the most serious condition of all. This condition requires refilling of the blood tracts as soon as possible. Intravenous infusion of saline solution, hypodermoclysis, proctoclysis, when practicable direct transfusion of blood, besides heart and nerve stimulants should be employed as indicated, and when practicable in the individual cases. Operation must be delayed for many hours as a rule.

The surgeon must thoroughly asepticize the injured member and absolutely control hemorrhage in these cases. He may then wait as long as forty-eight hours if necessary before operating.

As stated before, the first indication of gas bacillus or streptococcal infection makes immediate operation imperative.

In all cases of delayed amputation it is absolutely necessary to control all hemorrhage. It is best to do this when it is fully decided that an amputation should be done, by elastic constriction. When it is practicable the constrictor should be placed over the crushed tissues. When this cannot be done, place the constrictor immediately above the crush and prevent it from slipping by thrusting long sterile pins through the extremity just below the constricting bandage.

A Martin's rubber bandage applied from the fingers or toes upward and *over the crushed tissues to the margin* of uninjured tissues is best in case the limb has not been severed. This makes a safe and less painful constriction.

It is very important never to remove the elastic constrictor applied to control primary hemorrhage until the limb has been amputated. Thus the imprisoned micro-organisms which will inevitably develop in the injured area will not be set free in the circulation even for an instant. Besides it saves much time, as no attempt will be made to clean and disinfect what usually is a hopelessly soiled and infected area.

Points of Selections for Amputations.—As it was said before, this paper is intended to give the experience of one clinic and the lessons taught by this experience. The writer will not go into any argument with authorities either lay (that is the manufacturers of prothetic apparatus), or professional.

The rule should be to amputate as low down as possible in the upper extremity. An inch of length means a great deal in the usefulness of a stump of the forearm or arm. Even if irregular flaps, and in some cases doubtful flaps must be made to gain length in the stump, it is well to save all one can, and if the skin sloughs repair the loss by grafts later on.

Amputations of the lower extremity require a little discrimination in regard to this rule.

For the foot the writer believes the rule should hold, that is to say, leave as much as practicable. In the case of amputations any where in the foot, it is important to secure ample and good flaps. Fibrous tissue and contracted flaps with thin covering for the ends of the bones almost always produce painful and comparatively useless stumps of feet.

The clinic at St. Luke's Hospital uses mediotarsal amputations (Hay's and modifications of Hay's method) whenever practicable. Chopart's amputation has also given very useful and most satisfactory stumps. It is necessary to have good flaps and flaps which may be brought together without tension, and the anterior tendons should always be cut long enough to form a part of the anterior flaps and be secured by the sutures so they cannot retract. In this way the dreaded equinus produced by the unbalanced contraction of the soleus and gastrocnemius muscles through the tendo achillis may be avoided, and a perfectly movable, well balanced stump be obtained.

Pirogoff's amputation is very rarely used, as osteoplastic attempts are very doubtful expedients in crushed extremities.

Syme's is another amputation which has proven very useful and satisfactory.

Amputations of the leg whenever possible should be done through the lower third; they may be done as high as the junction with the middle and upper third, but very rarely if ever should they be done through the upper third. Upper third of the leg amputations give a mortality greater than at the knee-joint, and the resulting stumps are rarely satisfactory or useful.

Amputations at the knee-joints make very useful stumps. As a rule, the articulating surface should be sawed off so that the intercondylar groove shall be obliterated.

Amputations through the lower third of the thigh give very satisfactory stumps; the mortality is low and usually they heal rapidly. Above the lower third of the thigh the mortality rate increases rapidly. Upper third of the thigh gives very doubtfully useful stumps and the mortality is very high, though one would prefer to amputate there than go to the hip-joint.

Technic and Methods Used in Amputations.—The introduction of iodine as a rapid and efficient sterilizing agent for the skin has been a boon to the surgeon who has to deal frequently with large injuries. Since Grossich proved its value, the technic of preparation for operations and dressing of injured members has undergone a marked simplification in the clinic.

The patient is anæsthetized. Ether is almost always used by the drop method.

The elastic tourniquet is placed over the crushed tissues and carried just beyond the margin of the wound and fastened firmly in place by sterile muslin bandages, or by clamps, or by pins thrust through the tissues below it, and it is not removed until after the ablation of the part. No attempt is made to wash the end of an evulsed limb or the depth of a soiled wound when an amputation is to be done. The end of the limb or the crushed tissues and tourniquet are covered by sterile cloths which are firmly fixed in place, then the skin above the tourniquet is scrubbed with spirits of turpentine, and while the turpentine is still on it is shaved; again scrubbed with turpentine spirits, then scrubbed with alcohol, and thoroughly dried; then it is painted for a considerable distance over its whole surface with full strength of officinal tincture of iodine. This is allowed to dry, another sterile cloth is placed over the cloths which encompass the wound, and fastened in place. The limb is then elevated vertically, when possible, and another tourniquet adjusted at a point of selection above the region selected for the amputation.

The surgeon and his assistants thoroughly scrub their hands and forearms with soft green soap and running water, using a stiff brush, and disinfect with a 1 : 1000 bichloride of mercury solution and dry them on sterile towels. An amputation gown which covers the whole person including the forearms is put on, a respirator is adjusted over the mouth, a cap is placed over the hair, dry sterile rubber gloves are drawn on and upward over the lower part of the sleeve of the operation gown. Thus prepared, the amputation is done as rapidly as practicable.

As to Flaps.—There is no set rule in regard to them except that they must be wide and long enough fully to cover the stump without tension. It is preferred so to shape the skin flaps that drainage is facilitated by the lines of incision. As much muscle as practicable is included in the stump.

The flaps are formed from without inward and the skin is cut long enough comfortably to enclose the muscles without tension and so shaped that they may easily be adjusted; usually a periosteal cuff is raised and used to cover over the end of the sawed off bone. Osteoplastic operations are very rarely attempted, as it is very doubtful in the severe crushes how far up the injury has extended. Also the osteoplastic operations require more time. The saving of time is usually a very important matter. Besides, the result as regards usefulness of the stumps has been so uniformly good without them that the clinic never adopted osteoplasty in amputations. For the same reasons the cineplastic amputation methods are not used. In pathologic conditions, and in well-to-do patients cineplastic methods may be employed and prove useful.

Nevertheless the profession owes Ceci gratitude for developing the feasibility and usefulness of the cineplastic method.

Bunge's aperiosteal method also has not been employed.

It seems to the writer that osteoplastic and cineplastic methods of amputation offer many advantages in cases where amputations may be done deliberately and when the conditions calling for amputation are not those usually found in extensive comminutions and recent evulsions.

Thrombosis extends always a little distance from the edge of the injury. One never knows in any given case just how far the vessels are thrombosed. These plastic operations would require higher divisions of the bone and soft tissues in order to be quite sure of going through an area clear of thrombi. Besides they require more time to perform, and, as stated before in severe traumatic cases, rapidity of operating is very much to be desired.

Crile's suggestion to avoid "noci associations" by blocking the nerves with local injections of cocain or novocain is most valuable. In amputations this may be done rapidly and efficiently by the injection of the principal nerve trunks as soon as they are reached in the dissection before they are divided. This nerve blocking maintains the blood pressure and thus prevents the extension of shock to a fatal issue. It will be shown later on that the large majority of deaths after amputations for injuries occur within forty-eight hours after the operation from asthenia, due to severe forms of shock. All measures which will prevent or lessen shock should therefore duly be considered and be employed when necessary.

Hemorrhage must be most carefully controlled during the operation, and oozing prevented after the operation by ligating or twisting every bleeding point. The matter of oozing (so called) after amputation is not sufficiently considered by surgeons. Undoubtedly elastic constriction long continued, by paralyzing the local vasomotor control, contributes very considerably to this oozing after amputations. In very large limbs or in regions where the dissection must involve a large area, as in upper thigh and hip-joint amputations it is a question whether constrictions ought not to be avoided, and, what the writer has called " the gradual dissection method " be employed. That is to say, the same method one uses in dissecting away a breast and axillary glands for carcinoma, or removing any large tumor from the trunk. This method requires more time, but with the blocking method of Crile it may safely be employed. The freedom from oozing afterward more than counterbalances the extra time required. For shoulder-joint amputations and hip-joint amputations the writer recommends this method. It is well to remember that the first incisions should be so placed that the principal vessels can be reached and be ligated at the very beginning of the operation. The subsequent steps would consist in gradually extending the incisions and ligating or catching with hemostats every vessel as it is reached.

Of the ten hip-joint amputations done by the writer all but three were done after this method.

Results as Regards Usefulness of the Stump.—Of the 724 amputations of all kinds we have records of 18 re-amputations; 1 for conical stump of the upper arm in a young boy; 12 for conical or ulcerated stumps of the legs; and 5 for conical or painful stumps of the thigh. These cases emphasize an important point in regard to amputations near the upper epiphyses in young people. The growth of the shaft of the bones downward in children will nearly always produce a conical stump in a few years, especially in amputations in the upper parts of the arm and thigh. Parents should be warned of this fact. On account of the increased danger of death, however, the knowledge that re-amputation will probably be necessary should not induce the surgeon to make the primary amputation higher up. It is much better to amputate as low down as possible, thus gaining the benefit of the low mortality of the low regions and re-amputate when necessary later on. Conical stumps produced by natural growth of the bones are rarely painful unless irritated by the false limb or some other prothetic apparatus.

Barring these 18 cases all the patients who survived the amputations apparently had useful and healthy stumps. There is no note of any case of mediotarsal amputation requiring a second amputation.

Mortality after Amputations.—It must be borne in mind that the statistics given in this paper are really those of amputations for severe injuries. Only 50 cases are credited to pathologic conditions out of 616 single major amputations. Except from hip-joint amputations there is practically no mortality after amputations done for diseased extremities.

Eight (8) cases only are noted as having died of sepsis or of exhaustion later than forty-eight hours after the operation. In other words, practically all deaths after amputations occur within forty-eight hours after the operation. This fact brings home to the surgeon the immense importance of doing everything possible to conserve the strength and resistance of the patient. By far the most important factor in determining the death of a patient when the surgeon is a good asepticlan is *acute anœmia*. The writer has discussed this point frequently and has mentioned it very emphatically in the early part of the paper under the head "When to Amputate." It is not necessary to go into the matter further than to say that all the accumulated experience of thirty years' work in very active traumatic surgery goes to confirm the conviction that the saving of blood is the most important feature in traumatic work and that no major amputation ought to be attempted when a good instrument shows a very low blood pressure. Operations in these conditions should be delayed until by the various modern methods the vascular tension shall have been measurably restored.

Examination of the tables shows that single amputations of the upper extremity except at the shoulder-joint may be done practically without any death. Until the upper third of the leg is reached amputation of the lower extremity below the knee has a negligible mortality rate.

Knee-joint amputations give a very low mortality rate. Above the knee-joint the mortality rate rapidly increases. Middle third of the thigh amputations show a mortality twice that of the lower third, and the upper third amputations are 40 per cent. more fatal than those of the middle third.

Amputations of the hip-joint for crushes of the lower extremity must of necessity be exceedingly dangerous operations. The writer has done seven hip-joint amputations for injuries, two patients died, a mortality rate of 28.57 per cent.

Up to a short time ago the clinic had seven hip-joint amputations with but one death, then came three desperate cases of injury, and two of these died. The record stands at present 10 cases and three deaths, 40 per cent. mortality. This is a very high mortality rate, entirely too high, but it must be remembered that individuals who have such extensive crushes of their lower limbs that a hip-joint amputation is necessary, do not escape other serious injuries. In nearly every case there have been other regions of the body injured more or less severely.

Again, the writer must emphasize the point that of the deaths after single major amputations all but six died within forty-eight hours after the operation and they died from asthenia, chiefly from acute anæmia, which was brought about by hemorrhage before they reached the hospital. Later experience has taught us to defer amputation until the blood pressure has been restored to some extent. The statistics show that by this plan the previous mortality rate has been reduced materially.

Also, the post-operative oozing must sedulously be prevented. Too long continued and too tight elastic constriction provokes oozing by paralyzing the vasomotor constrictors. Always there is more oozing after the use of tight constrictors. Amputations at the hip-joint may be done almost bloodlessly by first ligating the femoral vessels at Poupart's ligament, then by careful dissection and the employment of a large number of hemostats control every vessel as it is reached, the extremity may be removed, and if all vessels be ligated or twisted scarcely any subsequent oozing will occur. We have found this a most efficient method.

Major amputations were at all ages from 10 years to 80 years of age, inclusive, at the clinic. The statistics show the deaths have all occurred, with one exception, in individuals between 15 and 45 years of age. One old man past 70 died. Age seems to affect the mortality very little.

What does markedly affect the mortality is the size of the extremity at the point of amputation. This applies to individuals of lean or plethoric condition. Other things being equal, the man with the small wizened extremity stands a much better chance of rapid recovery after amputations than the one with very large and fat extremities.

This fact accounts chiefly for the large increase in the mortality rate of amputations above the lower third of the thigh. Naturally in a large extremity the dissection is extensive, the wound is large, more blood will be lost and there is greater danger of sepsis.

The multiple injuries and mixed operations especially tax the discrimination of the surgeon both as regards measures for sustaining the strength of the patient and the kind and extent of the operations to be performed. The rules laid down in the foregoing pages apply to these cases, however, equally with the single major amputation cases.

The writer has come to the conclusion that it is not so much the loss of the solid tissues of the extremities but the tremendous "noci associations," and loss of blood which makes double and triple amputations so much more fatal than single ones.

The list of double amputations is large enough to enable one to draw useful conclusions but the triple and quadruple operations are too few to furnish more than suggestions.

At the clinic at St. Luke's Hospital the multiple operations are done synchronously. That is to say, the chief operator and the chief assistant operate at the same time on different extremities, each with a proper corps of assistants. This arrangement permits more rapid work and a shorter period of anæsthesia. Very great care is taken in hemostasis and the preservation of all the blood possible. Also saline infusions are used during and after the operation profusely. Morphia and cocaine, the one for general effect, the other locally, certainly have most efficient effects in these cases. Asepsis must most sedulously be carried out.

CONCLUSIONS.

A comparative study of the earlier and later lists of amputations shows that the clinic continues to regard the formerly adopted sites of preference the most desirable ones. The mediotarsal amputations have increased in number and have gained in favor against Syme's or the lower third of the leg amputations. Every increment of an extremity possible to save, without serious danger to the flaps and long disability of the patient, should be retained. The exception to this is the upper third of the leg. It is better to amputate at the knee-joint than at this region.

As regards the kind of flaps: for the forearm, anteroposterior flaps with the posterior one-quarter longer are preferred. All amputations of the arm, including those at the elbow, may be done by a circular or modified circular method. The adjustment of the flaps may usually be in an anteroposterior direction. The retraction of the anterior part of the flap at the elbow will convert a circular into an oval shaped flap, the posterior segment will be much longer. This will bring the line of union some distance above the end of the bone.

At the shoulder-joint, also, anteroposterior flaps are preferred. The anterior flap includes the greater part of the deltoid muscle and is longer than the posterior one. The incision in the internal aspect of the extremity should be so placed as to give easy access to the axillary vessels, which should be grasped and controlled as soon as practicable.

Mediotarsal and tarsal amputations are preferred whenever practicable when amputation of the foot is required. It is especially necessary to obtain good, adequate flaps and cut the anterior tendons long enough to be secured by sutures to the posterior flap when forming the stump.

Low down in the leg anteroposterior flaps are preferred but not the Teale method or any extraordinarily long anterior flap method. In other parts of the leg lateral flaps seem best.

At the knee-joint a long anterior and short posterior flap method is preferred. The patella may be removed or not, according to the conditions of the case.

Lower third of the thigh to the hip-joint anteroposterior flaps with the anterior one longer are usually employed.

We always shape the flaps from without inward, never by transfixion.

The average length of time in the hospital for amputation cases continues to be about 22 days.

The mortality rate for single major amputations has slightly been decreased, viz., from 4.76 per cent. to 4.36 per cent. The mortality rate of double mixed amputations has been reduced from 23.68 per cent. to 11.11 per cent. The combined mortality of the two series is 4.56 per cent. for the single amputations. This is a very low mortality rate for the class of injuries which required these amputations.

The important factors in lowering the mortality of amputations for injuries are:

1. Saving of blood.
2. Careful asepsis or antisepsis.
3. Discriminating when to operate.

The first two will no doubt appeal to every surgeon.

The last one may be resolved practically into the determination of the blood pressure. Operate as soon as the blood pressure will permit. A systolic pressure below 80 should contra-indicate amputation.

SNAPPING HIP (HANCHE A RESSORT; SCHNELLENDE HUFTE).*

BY JOHN FAIRBAIRN BINNIE, M.D.,

OF KANSAS CITY, MO.

Surgeon to the General Hospital, Kansas City.

J. L. K., male, twenty-four years, admitted to General Hospital, Nov. 19, 1912. Four years ago his right hip was caught between two railroad cars, causing an anteroposterior crushing. Was treated in another hospital, where he lay in bed 5 months; no splints were used. The hip was useless for almost a year. After recovery he was capable of doing light work.

He now has two complaints: (1) A marked rubbing pain at the crest of right ilium when he carries a heavy weight. This has no relation to the occurrence of his second complaint. (2) When he jumps or carries a heavy weight there is an audible and palpable snapping at the right hip, which he attributes to the head of the femur becoming dislocated and which he can produce voluntarily.

Examination.—When the patient leans slightly to the right side the tip of the eleventh rib touches the iliac crest, causing a painful rubbing on motion. There is now tenderness at this point.

This position of bending toward the right is often assumed in an endeavor to prevent snapping of the hip with its disagreeable sensation and feeling of weakness.

When sustaining most of his weight on the right foot, knee extended, if the patient leans toward his left, a thick band of tissue can be felt passing from the lower and anterior part of the trochanter major upward and backward toward the iliac crest. On extending the hip this band slides off the trochanter backward. If now he twists himself so that the right iliac bone moves forward the thickened band slips forward on the trochanter with a sharp " snap," which is palpable, audible at several feet and the jerking movement of the band is quite visible.

If the band is held backward with the fingers no " snap " occurs. The motions of the pelvis, which have been described, are equivalent to marked adduction and rotation outward of the thigh. In the recumbent position the phenomenon could not be produced. X-ray examination was negative.

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* Read before the American Surgical Association, May 6, 1913.

Diagnosis.—" Snapping hip."

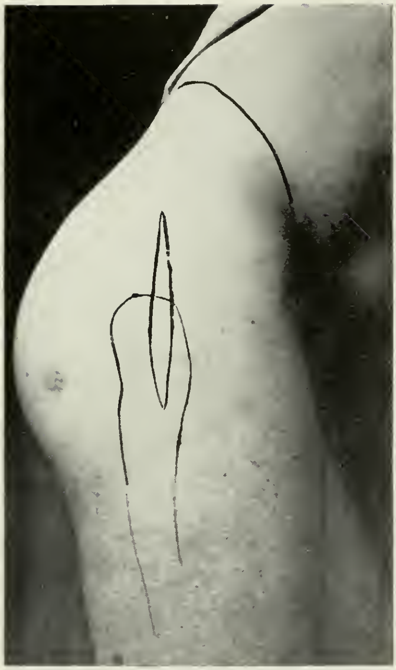
Nov. 20, 1912. Ether anæsthesia. Longitudinal incision over great trochanter. Corresponding incision through the *fascia lata.* There was a sausage shaped thickening of the fascia posterior to the wound and to the great trochanter (the fascio-gluteal tract of Heully).

A flap of the periosteum was raised by longitudinal incision from the femur at the lower part of the trochanter major and the posterior lip of the incised fascia lata was sutured to this and to the vastus externus muscle near its origin. The anterior lip of fascia was sutured to the posterior in such a manner as to slightly overlap the original line of suture. The skin wound was closed and the limb fixed in splints.

The patient was seen a month after operation when he was able to work. There was no recurrence of the snapping. To the patient the right leg now feels longer than the left, this, of course, being due to his ability to straighten the pelvis. The pain and rubbing at the crest of the pelvis has disappeared, because the patient no longer bends over to the right, bringing his eleventh rib into contact with the iliac crest as he formerly did.

Case II.—F. D., twenty-three. Male. April 20, 1913. Strongly-built man. About seven or eight years ago patient saw another boy creating interest by apparently voluntarily dislocating his hip and reducing it again with a delectable snap. He admired the accomplishment so much that he successfully imitated it. There is no disability except that the snap is apt to occur involuntarily when he lifts heavy weights. The phenomenon can be produced on both sides. The following is the sequence of events: Bears weight on foot, adducts thigh (or flexes pelvis to opposite side), slightly flexes knee and then a band moves from behind forward over the trochanter with a sudden jerk. By reversing the motions at the hip the band jumps back again to its retro-trochanteric position. The snap both when the band moves forward and backward is visible, palpable and slightly audible. The band is *not* the iliotibial band, but is evidently the anterior margin of the gluteus maxi-

Fig. 1



Showing relation of snapping band to great trochanter.

mus, it follows an oblique line from about an inch anterior to the posterior superior iliac spine downward and forward to the outer surface of the femur five inches below the tip of the great trochanter. This is the location of the band just as it is ready to make its forward snap. The band is about the thickness of a forefinger. (Fig. 1.)

Thomson and Miles in their small but very satisfactory *Manual of Surgery* (Ed. 1912) write of snapping hip that "it is now believed to be due to the tensor fasciæ femoris slipping backwards and forwards over the trochanter."

Perrin in 1859 presented to the Societe de Chirurgie a case which he considered to be one of "voluntary dislocation of the hip." In the discussion which followed it was clearly shown that no dislocation of the bone was present, but that the symptoms were due to action of a muscle or band of fascia gliding and jumping over the great trochanter.

Schoemaker (*Zeitschr. für Orthop. Chir.*, 1901, viii, 444) in a paper entitled "Hysterische Huft-haltung" wrote, "there is no subluxation of the hip, the snapping which is produced by slight movements of the hip ought to be attributed to the tense fascia lata passing over the trochanter."

Bayer (*Archiv für klin. Chir.*, lxxxii, 266) was the first to operate successfully for snapping hip. In his case he made the diagnosis of subgluteal bursitis (hygroma), but on opertion found lax connective tissue and *no* bursa between the tendon of the gluteus maximus and the trochanter. He attributed the symptoms to laxity of the tendon and obtained a cure by an operation similar to that which I have described.

Frequently "snapping hip" follows or is the result of trauma, but Staffel reports that he had been telling a colleague about a case of voluntary dislocation of the peroneal tendons (common amongst spirit rappers) when the colleague replied, "That is nothing at all; I can snap with my hip," and proceeded to show that when he extended his hip a tendinous band of fascia sprang backward over the trochanter with palpable, audible, visible snap.

Staffel quotes Zur Verth as follows: In my youth I had often to stand for a long time, and to pass the time was accustomed to produce, as I then thought, a dislocation first of one hip and then of the other. Under certain conditions the imaginary dislocation occurred easily and without pain, but with an audible and palpable snap, and snapped back again as easily and painlessly. No ill results followed this practice. . . . When I became a medical student and learned more about dislocations I changed my diagnosis from luxation to subluxation until forced by the publication of recent researches to discard that idea also, and to accept the explanation that the phenomenon was due to the gliding of a band over the trochanter major.

These two cases are apparently not of traumatic origin, and certainly there was no disability resulting. In both, the phenomenon was evidently due to the passing of a band over the trochanter or the band being fixed, to the passing of the trochanter under it.

Ferraton (*Rev. d'Orthopedie,* 1905, p. 45) quoted by Heully and others; operated on a recruit under local anæsthesia. An oblique incision was made upward and backward from the posterior border of the trochanter major in the direction of the fibres and parallel to the anterior border of the gluteus maximus. The anterior fibres of the muscle were penetrated. Exposure of the trochanter showed no lesion. The subgluteal bursa was normal. Voluntary flexion of the thigh provoked a " snap " and at that moment the great trochanter was seen to pass under the muscular mass composed of the anterior fibres of the gluteus maximus. If the muscular mass was hooked up with the finger no snapping could be produced.

Voelcker (*Beitrage z. klin. Chir.,* lxxii, 619) reported a case of bilateral snapping hip.

Right side. When patient lay on his left side he could produce the snap on the right. Local anæsthesia.

Longitudinal incision behind the trochanter. Division of the fascia behind the palpable, thickened and visibly retracted iliotibial band, exposure of the subjacent fibres of the gluteus maximus which were divided in the line of the incision. Snapping was possible after division of the fascia but not after division of the muscle. A mucous bursa, 6 cm. in diameter, was seen lying on the trochanter and excised.

Left side. Division of fascia as on opposite side. The gluteus maximus was united to the iliotibial band by a strong tendon which received fibres from the gluteus in a penniform manner. As soon as this tendon was divided snapping became impossible.

No suture of fascia to trochanter. No recurrence.

Heully reports a case from the service of Prof. Gross. A solidly built man fell on his right hip—kept on at work but with pain and limping. From time to time there was an abnormal bruit in hip. Six months later he had stooped to pick up a weight when he was straightening himself with the weight, he felt a sharp pain in the hip and was unable to stand up at once. When he did get up he noticed a marked crackling in the hip. Subsequently when he carried weights he had to bear his weight on the left limb.

Examination when the patient was standing showed a muscular prominence apparently due to the tensor fascia lata and accentuated by a depression over the surface of the trochanter major which made the right iliac region appear prominent. The posterior border of the prominence was 6 cm. behind the anterior superior spine.

The same muscular prominence was seen on the left side and played no rôle in the production of the symptoms.

On active flexion of the hip to a right angle the following phenomena occurred: 1. Under the skin covering the lower part of the trochanteric depression there appeared an elliptical prominence about 1 cm. wide and 3 cm. long. It appeared when the flexion reached 15°. 2. When the flexion reached about 45° this prominence suddenly glided forward. 3. At the same instant there was a single dry bruit, like an articular crackle or crepitation.

Palpation of the mobile prominence showed it to be a firm, flattened mass continuous with a band which went obliquely upward toward the iliac crest. The firm mass was 6 cm. below the iliac crest. When the thigh was flexed and rotated inward the band became vertical. . . . The phenomenon only occurred on flexion of the thigh on the pelvis or *vice versa*—it never appeared on rotation or inclination of the pelvis. It was easy to determine the exact position of the mass which caused the snap. The upper border was easily found and was 12 cm. from the anterior superior spine. The subtrochanteric crest was as easily made out; between these was the outer surface of the trochanter. On flexion an elongated mass showed upon the upper part of the thigh on a vertical line passing along the posterior border of the great trochanter. The inferior extremity of this mass was 6 cm. below the tip of the trochanter, the superior extremity reached nearly to the subtrochanteric crest. When flexion attained 45° it suddenly glided forward 3 cm., producing a noise perceptible at a distance. . . . When flexion attained 90° the band prolonging the mobile mass upward was vertical, at 45° it was slightly oblique downward, backward and inward.

Operation showed that the upper part of the femoral insertion of the gluteus maximus tendon was separated for about 1 cm. and formed a prominence, about a finger breadth wide, on the deep surface of the muscle. This was the mobile mass which caused the snapping. The band passing upward toward the iliac crest consisted of the anterior border of the muscle, the fascio-gluteal tract. By passive motion it was possible to reproduce the snapping and to ascertain its true cause, viz., undue mobility of the tendon of the gluteus maximus. Suture of the posterior edge of the wound in the aponeurosis—*i.e.*, the portion of the fascia united to the muscle, to the periosteum of the trochanter and to the vastus externus led to cure.

Nelaton, imagining that the trouble was due to an atypical subluxation, decided to suppress internal rotation so as to prevent the great trochanter from moving too far from the ischium. He dissected a flap as large as the index finger and 25 cm. long from the upper part of the semitendinosus. The pedicle of the flap remained attached to the ischium. He bored a hole through the great trochanter and pulled the free end of the flap through the hole from the digital fossa outward and sutured it to the periosteum on the outer surface of the bone. The flap was long enough to permit of flexion of the hip but prevented rotation inward. Result good.

Out of 41 cases of snapping hip collected from various sources 16 appeared due to trauma, 1 to fatigue and 10 were either congenital or the result of practice. In the rest of the cases the origin was doubtful, some of the patients being military recruits unimbued with professional enthusiasm; others, workmen seeking to take advantage of state insurance and some in which no history was available.

In 17 cases there was a varying degree of disability, in 12 there was no disability, in the rest there was doubt as to disability or no history.

Causes of Snapping Hip.—The following are some of the conditions blamed for the occurrence of snapping hip.

1. Inflamed serous bursæ. It may be remarked that bursitis has been diagnosed before operation, but that during operation no such condition has been found.

2. Malformation of the joint—*e.g.,* enlargement of the articular cavity; increased length of the neck of the femur; increased prominence of the trochanter major.

3. Repeated, involuntary tic like muscular contractions.

4. Simple voluntary contraction.

5. Muscular relaxation. Kusnetzoff and Pupovac think voluntary contraction alone is incapable of producing the snap. True, it is produced during voluntary contraction, but this only puts the real cause in evidence. To Kusnetzoff the real cause is a relaxation of the gluteus maximus due to hemorrhage while Pupovac says, " I admit that the normal fixation of the iliotibial tract is destroyed by a partial tear of the mus-

cular fibres behind the great trochanter." Bayer thinks trauma causes laxity of the gluteus tendon and this permits the fibres of insertion to glide over the trochanter during active and strong rotation while the gluteus is contracted.

Zur Verth believes that a contracted gluteus maximus prevents "hanche a ressort," but that if paralysis weakens the muscle, if a tear separates its transverse fibres from the iliotibial band, if it is elongated by cicatricial tissue, then a sufficient amount of hip flexion determines the snap when the iliotibial band is tense. The necessary tension is obtained by lowering the opposite side of the pelvis (*i.e.,* adduction of the thigh). He writes, "Snapping hip is caused by a trauma acting on the iliotibial band (cristo-femoral tract) or the gluteus maximus and diminishing its contractile power." He also thinks that any one who can voluntarily relax the gluteus maximus is a potential hip snapper.

6. Foreign bodies in or about the gluteal bursa have been considered causes.

7. Heully in a very elaborate article and from experiments on the cadaver came to the conclusion that in traumatic cases the trouble was due to rupture of the upper part of the femoral insertion of the gluteus maximus, the divided tendon remaining as a sort of knob on the under surface of the muscle which still acted of course by means of its aponeurotic insertion. The knob of tendon sliding or bumping back and forth over the trochanter major, according to Heully, occasions the audible, visible and palpable snap.

Heully's explanation does not account for the numerous congenital or non-traumatic forms of the trouble. The writer has twice performed Heully's experiment on the cadaver, but found it impossible to produce any approach to a snap with the knob-like stump of the gluteus tendon, and found that the finger placed between it and the bone while the limb was abducted, was not even pinched to any marked degree when the limb was then adducted, flexed and rotated. If, however, the finger was placed between the lower part of the trochanter and the anterior edge of the gluteus maximus it was painfully pinched. This seemed more marked after than before the tendon was divided.

Heully noted the same pinching under the anterior edge of the gluteus maximus (fascio-gluteal tract) but does not consider this the cause of the snapping. The iliotibial band has often been described as the band which passes over the trochanter with a snap but it is situated rather too far forward to be really culpable.

The fact that any operation which fixes the anterior margin of the gluteus maximus to the trochanter and to the vastus externus is successful in preventing snapping seems to show that the structure is the culprit. This notion is strengthened by Ferraton's observation that when he hooked up the fascio-gluteal tract with his finger, snapping became impossible. Voelker's division of the upper fibres of the muscle gave a good result, probably because he obtained such a great lengthening of the tract that no tension on it was possible. Possibly rupture or division of the femoral insertion may permit a retraction upward and backward of some of the muscle fibres, enough to cause a sausage shaped swelling of the muscle about its anterior margin and so increase the possibility of the peculiar jumping of this tissue over the trochanter when the proper movements are made.

FIVE CASES OF SUTURE OF THE HEART.*

BY FRANCIS T. STEWART, M.D.,
OF PHILADELPHIA.
Professor of Clinical Surgery in Jefferson Medical College.

The heart, so far as we are aware, has been sutured 11 times by Philadelphia surgeons, once by Harte, once by Mitchell, once by Bradbury, once by Billings, twice by Gibbon, and five times by ourselves. Six of the patients recovered. Harte, Mitchell, and Gibbon have already reported their cases; Bradbury and Billings intend to publish theirs shortly; and the details of our cases will be found below.

Case I.—T. E., aged twenty years, colored, cook, was admitted to the Jefferson Hospital, February 29, 1904. He had been stabbed in the chest with a long, rusty penknife. The stab caused severe pain, but neither felled him to the ground nor caused him to feel faint. He walked without assistance to the hospital, a distance of one and a half squares, then began to feel weak, and was found crawling up the steps leading to the entrance of the hospital. After being disrobed a small wound was found just above the third rib, about one inch to the left of the left margin of the sternum. The wound was surrounded by an emphysematous swelling, and bled continuously, the stream of blood being accelerated by each expiration. The temperature was 97 degrees, and the pulse 80, empty and markedly irregular in volume and rhythm. He lay on the right side, breathing 40 times per minute in a short, jerky manner. At times he would complain of a little pain and severe dyspnœa. He was sweating and very pale, and had vomited once. There was neither cough nor blood spitting. The entire left chest was tympanitic on percussion. On auscultation the heart beats could be heard indistinctly; there was no bruit or splashing sound. Under ether anæsthesia operation was begun about 45 minutes after the infliction of the injury. Time of operation about 45 minutes. Amount of ether four ounces. An incision was carried along the second rib for four inches to the sternum, then down the left margin of the sternum to the fourth rib, and outward along the fourth rib for four inches.

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* Read before the American Surgical Association, May 7, 1913.

The musculocutaneous flap was dissected back, and the opening in the chest found between the third and fourth ribs. The exposure was then made more complete by continuing the sternal incision downward for two inches, and the triangular flap thus formed retracted. The third and four ribs were severed and forcibly turned toward the right, fracturing the costal cartilages near the sternum. The knife had passed through the anterior edge of the left lung, the lung had collapsed into the vertebral gutter, and the pleural cavity contained a large quantity of clotted and fluid blood. The opening in the pericardium was easily found by the spurting of blood with each pulsation of the heart; it measured about three-eighths of an inch. The pericardial wound was enlarged in the axis of the heart, and a penetrating wound of the anterior wall of the left ventricle found. This wound was parallel to the axis of the heart, nearer the auricle than the apex, and measured about three-quarters of an inch (larger than either the skin, intercostal, or pericardial wound). Bleeding from this wound was free and continuous, whether more marked during diastole we are unable to state, as the heart was now beating very rapidly and resembled a quivering mass of muscle. The wound was closed with a continuous silk suture (six stitches), the sutures being inserted and tied without reference to diastole for the reason already stated. During the suturing the descending branch of the left coronary artery was punctured near its origin with the needle, causing a profuse hemorrhage, which was controlled by an additional suture. The pericardial and pleural cavities were cleared of blood, and the pleural cavity was irrigated with salt solution. The pericardial wound was sutured with a continuous silk suture, a small opening being left at the lower end for the passage of a gauze drain. No attempt was made to suture the lung, as it was not bleeding. A gauze drain was placed also in the pleural cavity, gaining exit at the lower part of the primary incision. The costal cartilages were sutured with catgut, the skin with silkworm gut. During the operation twenty-four ounces of salt solution containing adrenalin were injected into the circulation, and strychnine and atrophine were administered subcutaneously. At the end of the operation the temperature was 100.4 degrees; the pulse 150; the respirations 32.

The following day the temperature was 103.4 degrees, the pulse 130, the respirations 56. The patient was delirious and coughed frequently. The fever, the rapid pulse, and the rapid respirations continued for 2 weeks. The cough gradually grew better after the second week; there was never any expectoration. During the first few days there was a copious discharge of blood-stained fluid from the wound. On the fifth day the left chest was dull on percussion, and rough breathing with crepitant rales could be heard over the lower part posteriorly. Examination of the blood at this time showed: erythrocytes, 3,630,000; leukocytes 38,800; hemoglobin, 58 per cent. The chest was explored with an aspirating needle, with a negative result. On the sixth day pus appeared in the wound. Some of the cutaneous sutures were removed on this day and the rest on the eleventh day. On the thirty-fifth day the patient was allowed out of bed. On the fifty-sixth day he was discharged to return to the out-patient department for dressing, a small sinus leading down to the point where the ribs were severed still persisting; this sinus closed a few days later. The pulse varied between 80 and 90. Adventitious sounds were never heard over the heart. The left chest expanded very little on inspiration, and slightly roughened breathing, but no rales, could still be heard.

The facts just narrated were reported to the College of Physicians of Philadelphia, May 4, 1904 (Am. Jour. Med. Sci., Sept., 1904), *i.e.,* a little over two months after the operation. The subsequent history of the case is now published for the first time. Some weeks after leaving the hospital the sinus reopened and finally discharged a long silk thread, probably the one that had been put in the pericardium. The patient worked as a janitor and subsequently as a delivery man for a grocer, an occupation necessitating the handling of heavy baskets and boxes. His health remained good up until the summer of 1908, when he was readmitted to the Jefferson Hospital for tuberculous inguinal adenitis. At this time ether was administered and the caseous glands removed. There were no symptoms referable to the heart or the lungs. Shortly after this operation, however, signs of pulmonary tuberculosis developed, from which disease he died, Feb. 14, 1909, 5 years after the injury to the heart. The notes of autopsy, which were kindly made by Dr. Krumbhaar, follow:

Anatomical Diagnosis.—Pulmonary tuberculosis (extensive, bilateral, with cavities and small areas of gelatinous pneumonia). Chronic adhesive pericarditis (following stab wound). Localized chronic interstitial myocarditis and antemortem thrombus (left ventricle). Chronic adhesive pleurisy (bilateral). Operative scar on left chest. Anæmic infarct of spleen. Slight red atrophy of liver. Chronic interstitial orchitis.

Heart.—After considerable dissection the heart is separated from the parietal pericardium. It is free only for a small area about the apex. Over most of its surface are somewhat cobwebby, fibrous adhesions, that are broken up without much difficulty. In one spot, however, over the anterior surface of the ventric septum, the size of a silver dollar, the adhesion is very dense, so that it has to be cut with scissors. The heart is but slightly enlarged, weighs 370 grams. It is fairly firm, the color being obscured by the thickened pericardium. On opening, the musculature of the right ventricle is found to measure 4.7 mm. and to be a normal reddish-brown, except under the area of the dense adhesions, where it is much more yellow, though firm. On dissecting away the fibrous tissue over this, it is very hard to tell where the musculature begins. The cavity of the left ventricle is large, the muscle 12-14 mm. thick and of normal color, except under the above mentioned area, where it is much yellower. Toward the apex in the region of the septum it is much thinned and distinct grey lines can be seen running through it. Greyish-red spots, which on dissection show distinct lines of Zann, are firmly adherent to the septal region. The mitral valves show occasional yellowish dots, the aortic valves are normal. There are occasional slight thickenings of the intima of the aorta. The coronary arteries are free from sclerosis. On dissecting out the branch to the ventricular septum, it is suddenly lost at a point 3 cm. below the auriculoventricular septum and has evidently been obliterated.

Lungs.—Both lungs are enlarged and riddled with tuberculosis. On removing the right lung, which is rather extensively adherent to the parietal pleura, a quantity of purulent fluid escapes. This is found to come from a large cavity occupying practically all of the upper lobe, which is ruptured on removal. The lung is everywhere filled with small and conglomerate caseous tubercles and occasional small cavities are found. The process seems less advanced and more acute in the inferior lobe, where the tissue has a gelatinous, homogenous appearance. The left lung presents a similar appearance to the right except that the cavities are fewer and smaller and no gelatinous areas are found.

Microscopic examination of the heart.—Sections show epicardial fat to be in most places replaced by a fairly dense fibrous tissue, in which small vessels are numerous. The tissue stops raggedly and no epicardium is visible. Throughout all sections there is a marked increase of interstitial tissue, in some areas about blood vessels, in others rather diffuse, while in some, large spaces are found with practically no muscle fibres in them. These contain numerous small vessels. The muscle fibres are in good condition, except those on the edge of or in the isolated fibrous areas. Section through the wall and thrombus shows the same condition of the heart wall, with thrombus closely applied to the endocardium. In no case, however, is the endocardium broken or missing, and no organization of the clot is found. The clot consists of a fibrinous network enclosing many or few leukocytes, alternating with areas in which the red blood cells predominate. Section through the septum immediately inferior to the supposed site of the wound shows the interstitial fibrosis to be even more marked. The muscle fibres in less involved areas are thin and often wavy with loss of cross striæ. The epicardial area shows numerous vessels, including one large one, that are normal, and several nerves cut in cross section. About these and in their capsules are fairly numerous connective tissue cells. No thrombosed vessels are found.

Case II.—A. J., aged thirty-six years, colored, laborer, was admitted to the Pennsylvania Hospital Feb. 15, 1909. He had been stabbed with a long knife and had started at once for the hospital. After walking about 2 squares he fainted, and was carried into the hospital pulseless and unconscious. He soon revived, however, and when we saw him the pulse was 100, but very weak, the mucous membranes pale, the temperature 97.4° F., the respirations 26. He was conscious and did not complain of pain. The whole left chest, including the cardiac area, was tympanitic, and emphysematous crackling could be felt beneath the skin of the left breast. The heart sounds were weak, but there were no murmurs. Under ether the operation was begun one hour after the injury and lasted 15 minutes. The knife had entered the skin at the middle of the left anterior axillary fold, split the pectoral muscles, and penetrated the second intercostal space midway between the primary wound and the sternum. An incision was made along the second rib from the sternum to the level of the wound in the intercostal space, then downward to the fourth interspace, and inwards to the sternum. The third and fourth ribs were severed at the level of the longitudinal incision, and the flap thus formed turned back over the sternum by fracturing the costal cartilages. The internal mammary artery was not seen. The lung was collapsed and apparently not wounded. The left pleural sac contained a large quantity of blood. An opening large enough to admit the finger was found in the upper anterior part of the pericardium. This was enlarged in the axis of the heart and a wound about ½ inch long found in the left ventricle near the auriculoventricular juncture and near the interventricular septum, the wound running parallel with the septum. It bled continuously, but the bleeding was more marked during the cardiac diastole. The wound in the heart was approximated with rat-toothed forceps and so held while a continuous silk suture (4 insertions) was inserted. The pericardial sac was not distended but contained considerable fluid blood and a long red rope-like clot. After removing this blood the pericardium was sutured with catgut. The pleural cavity was drained by means of a rubber tube inserted through an incision in the seventh interspace in the posterior axillary line. The severed costal cartilages, the interchondral spaces and the pectoral muscles were sutured with catgut, the skin with silkworm gut. A gauze drain was inserted in the stab wound as far as the chest wall. No stimulants were given before the operation; during the operation strychnine gr. 1/30 was injected subcutaneously. At the completion of the operation the pulse was 100, the respirations 36, the temperature 97 degrees.

The following day the temperature was 102.6 degrees, the pulse 120, the respirations 60. The temperature remained between 101 degrees and 103 degrees for 10 days, then slowly fell until it reached normal on the 26th day; the pulse and respirations behaved in a similar manner. On the third day the gauze wick was removed from the stab wound and the rubber tube from the pleural cavity, both having ceased to drain. The skin sutures were removed on the eighth day, and several ounces of pus evacuated from beneath the upper and outer angle of the flap. There was no pus in the original stab wound or in the pleural wound; both were closed. All wounds were healed on the 25th day. On the 30th day the patient was permitted to sit up and a day or two later to walk. The temperature having been normal for 16 days, suddenly on the 42nd day ascended to 101 degrees. Examination of the chest by Dr. Newlin revealed a precordial area of dulness, extending from the right edge of the sternum to one cm. beyond the nipple line and from the clavicle down to the stomach. The apex of the heart could be felt in the fifth interspace, midclavicular line. The heart sounds were feeble and rather distant. At the aortic cartilage the second sound was split. Below the left clavicle and in the left axilla the breath sounds were feeble, distant, and tubular. The lower chest posteriorly was tympanitic; no fluid could be obtained by aspiration. Several days later a skiagram was made, and showed a dense area corresponding to that which had been outlined by percussion. The temperature continued above normal until the 52nd day, when after several unsuccessful attempts to obtain fluid by aspiration the fourth rib between the axillary lines was resected and about one pint of thin yellow pus evacuated from the pleural cavity. Two weeks later (65 days after the original operation) the patient left the hospital with a discharging sinus. At the present time (May, 1913), he is languishing in the penitentiary for burglary. The heart is acting normally and there are no murmurs.

CASE III.—E. M., aged twenty-six years, colored, was admitted to the Pennsylvania Hospital June 17, 1910. He had been stabbed with a pair of scissors. There was a transverse wound in the skin one and a half inches long, in the third intercostal space close to the sternum. The temperature was 95 degrees, pulse 130 and irregular, the respirations 30. The mucous membranes were pale, the patient conscious, and the veins of the face, neck, and arms distended. There was some emphysema below the wound in the skin. The heart sounds could be heard faintly but no murmurs were detected; cardiac dulness extended from the right margin of the sternum to the nipple line. Auscultation and percussion over the rest of the chest were negative; there was no pneumothorax. Before we reached the hospital the resident physician attempted to infuse salt solution into a vein of the arm, but the intravenous pressure was so great that the solution would not run into the vein. Operation was begun two hours after the injury and lasted 35 minutes. On introducing a finger into the external wound it passed downwards and entered the thorax in the fourth interspace close to the sternum. A straight incision was made from the inner angle of the original wound downwards along the margin of the sternum to the fifth costal cartilage. The fourth costal cartilage was then severed at its sternal end and with the underlying triangularis sterni turned outward without injuring the pleura. It was now found that the wound in the pericardium was up beneath the sternum on a level with the third costal cartilage, which therefore was turned outward like the fourth costal cartilage. Subsequently, in order to obtain more room the fifth costal cartilage was treated in a similar manner, the incision along the margin of the sternum being continued downward to the sixth rib. Thus there was a triangular chondrocutaneous flap containing the fourth and fifth cartilages. The third cartilage was detached from the skin but hinged to the chest by muscular tissue. The pleura, with the lung, was separated bluntly from the pericardium and retracted outward. The pleura was not injured either before or during the operation. The pericardium was tensely distended, liver-colored, and not pulsating. There was no bleeding from the pericardial wound until it was enlarged, when a large amount of fluid and clotted blood escaped, and the pulse immediately fell to 80 and became regular. The cardiac wound was transverse, one-quarter inch long, and in the right auricle. The bleeding from the heart was continuous, the stream spurting about two feet. A finger was placed over the wound and two catgut sutures (No. 3) inserted. Four additional sutures of fine catgut were needed to control the bleeding from the suture holes. The pericardial sac was irrigated with salt solution, the pericardium and the costal cartilages were sutured with catgut, and the skin wound was closed with silkworm gut sutures. Drainage was omitted. At the end of the operation the temperature was 95°, the pulse 116, and the respirations 30.

The following day the temperature was 101 degrees, the pulse 120, the respirations 40. The fever persisted for about one week, when the superficial stitches were removed and a few drams of pus evacuated. The wound healed subsequently without extension of the infection. On the second day the systolic blood pressure was 115, the diastolic 85; hemoglobin 78 per cent. R. B. C. 3,335,000, leukocytes 15,500; polynuclears 82 per cent., lymphocytes 10 per cent., mononuclears 2.5 per cent., transitional 2 per cent., undetermined 3.5 per cent. The patient had a slight cough for about two weeks, but no abnormal physical signs could be detected in the chest. On one occasion the sputum was faintly blood tinged; no tubercle bacilli were found. The patient was kept in bed two weeks and had completely recovered by the end of the third week. He remained in the hospital, however, for two months, performing the services of an orderly. He was last seen in the spring of 1912 (two years after operation) at which time he was in perfect health; no adventitious sounds could be heard over the heart.

Case IV.—J. S., aged twenty-three years, colored, laborer, was admitted to the Pennsylvania Hospital July, 1910. He had been stabbed in the chest with a knife during a brawl and was found by the police "lying in a pool of blood." He was unconscious when he reached the hospital, but partly revived before the time of operation. The temperature was 96, the pulse 90 and very weak, the respirations 28. There were drops of sweat on the face, which was very pale. In the fifth interspace directly under the nipple was an almost horizontal wound, one inch long, which entered the thoracic cavity, oozed blood continuously, and was surrounded by an emphysematous swelling. The left chest was tympanitic. The heart sounds were faint but distinct and there were no murmurs. The operation was begun one and a half hours after the injury and lasted 40 minutes. An incision was carried from the inner end of the stab wound inward to the sternum, then upward along the left margin of the sternum to the third intercostal space. The fourth and fifth costal cartilages were severed near the sternum, and the flap turned outward by fracturing the cartilages at the axillary extremities. The left lung was collapsed and the pleural cavity contained a large quantity of blood. The pericardial wound, which was oozing blood, was enlarged, and a transverse wound, about one inch long, found in the left ventricle near the apex. Blood was spurting from this wound, which was temporarily closed with the finger while a continuous catgut suture (seven insertions) was applied. It was necessary also to tie a large branch of the coronary artery which ran to the wound. At this time it was noticed that the cardiac muscle around the wound, over an area of about one inch in diameter, appeared to be abraded. A large amount of clotted blood was removed from behind the heart, the pericardium and the costal cartilages sutured with catgut, the skin with silkworm gut. A rubber tube was inserted into the pleural cavity through a short incision in the seventh interspace, post axillary line. During the operation one pint of salt solution was given intravenously. At the end of the operation the temperature was 94.6, the pulse 100 and very weak, the respirations 30.

The next day the temperature was 103, the pulse 140, the respirations 60, the leukocytes 4,600, the hemoglobin 76 per cent., the red cells 2,500,000. The pulse and the respirations continued rapid and the patient died 41 hours after operation. The autopsy notes follow:

Anatomical Diagnosis.—Infected stab wound of left ventricle. Acute fibrino-purulent pericarditis. Acute myocarditis. Acute vegetative endocarditis of mitral and aortic valves. Acute fibrino-purulent pleuritis (left side).

The left lung is collapsed and consolidated, the left pleural cavity filled with yellowish fluid, and masses of fibrin resembling custard. This fluid had not drained through the tube because of adhesions which had formed between the lung and the chest wall in front of tube. The pericardium is filled with the same sort of material as the pleural cavity.

Heart.—The heart measures 14 x 9 x 4.5 cm. and weighs 480 grams. On the anterior surface of the left ventricle, beginning about one cm. above the apex and extending upward toward the base just to the left of the septum, is an area, measuring 3 x 1.5 cm., which is slightly depressed below the surrounding muscle and is of a light greenish-grey color. The main descending branch of the left coronary artery runs just to the right of this area. A large branch of this artery, which is given off about 3 cm. above and admits a probe of about 2 mm. diameter, runs to the border of this area and is lost in the greyish, soft tissue. In the middle of the above mentioned grey, depressed area is a wound measuring 3 cm. in length closed by a continuous catgut suture. Sagittal section of the wound shows it to extend into the muscle obliquely, slightly bearing toward the septum. It is about 12 mm. in depth. It does not seem to extend into the left ventricle, there being a ridge of tissue about 2 mm. thick intervening between the bottom of the wound and the endocardium. On the endocardial surface immediately beneath the wound there is a small amount of smooth, elastic, soft, chicken fat clot which is easily pulled away, leaving an apparently smooth endocardium. Section of the heart muscle about the wound shows an area on each side of the wound which is soft and greyish and rather sharply demarcated from the surrounding heart muscle. At the extreme tip of the left ventricle is a yellowish-brown streak in the heart muscle fading gradually into the normal muscle. The muscle at some distance from the wound is uniform, brown, and seems normal. The right auricle, tricuspid valve, right ventricle, and pulmonary auricle appear normal. Along the line of closure of the auricular surface of both flaps of the mitral valve is a line of small vegetations. A slight amount of red elastic fibrin is adherent to these vegetations. They are of about pin-head size and in places conglomerate. Similar acute vegetations are present along the ventricular surface of the leaflets of the aortic valve. The aortic vegetations are similar to those on the mitral valve but not so extensive. The arch of the aorta above the valves is smooth and patchless.

Microscopical examination of Heart.—A series of sagittal sections was made through the region of the wound in the left ventricle. All sections are similar. They show a heavy fibrinous exudate on the pericardial surface mixed with clumps of cocci. A large coronary artery in the section is occluded by a thrombus. The adventitia is necrotic and pink-staining, and in it are seen deep blue-staining masses of bacteria. On each side of the wound there is a wide band of hyalin, necrotic muscle fibres showing here and there a glial mass of bacteria. Beyond this there is a zone of intense leukocytic infiltration with some fibrin and hemorrhages. There are bacterial emboli in some of the vessels. Beyond this still are seen fairly normal muscle fibres. The deepest portion of the wound is glued together by a thrombus about 1.5 mm. thick, composed of hyalin, fibrin, leukocytes, and red blood cells, *i.e.*, the wound penetrated into the ventricle. A few of the muscle fibres on each side of this are necrotic and there is some infiltration of leukocytes between them.

Case V.—G. E., aged twenty-one years, colored, laborer, was admitted to the Pennsylvania Hospital Jan. 1, 1911. The police had found him lying in an alley and thought he was dead. His temperature could not be ascertained, as it was below 94, the lowest mark on the thermometer; this low temperature was due in part to the state of the weather, which was very cold. The patient was unconscious, pale, pulseless, and breathing six times to the minute. The left chest was tympanitic anteriorly, dull posteriorly; the heart sounds could not be heard. He was revived somewhat with stimulants, so that at the time of operation the pulse was 108, but scarcely palpable, and the respirations 52. He was still unconscious, but it was necessary to give a little ether because of his tossing about. The stab wound in the skin was in the second left interspace about one inch from the sternum, the wound in the intercostal muscles in the third interspace, the wound in the pericardium beneath the third costal cartilage, and the wound in the heart beneath the second costal cartilage. An incision was made from the original wound to the sternum, then downward to the fourth interspace and outward; the third and fourth costal cartilages were severed near the sternum and the flap turned outward. The left lung was collapsed and the pleural cavity contained a large quantity of blood. The anterior edge of the lung had been perforated but was not bleeding. At one point it was bound to the pericardium by a band as thick as a finger. The pericardial wound was enlarged and a wound found in the right ventricle; this was closed and the heart steadied with rat-toothed forceps while a continuous catgut suture (3 insertions) was applied. A large amount of clot was removed from behind the heart, the pericardium and the costal cartilages sutured with catgut, the skin with silkworm gut. Just after the heart had been sutured the patient stopped breathing and the pulse fell to 52. Artificial respiration for several minutes was followed by spontaneous breathing. During the operation one quart of salt solution was injected intravenously. At the completion of the operation, which lasted about 25 minutes, the pulse was palpable but uncountable, the respirations 60.

The patient died one hour later, the respirations becoming slower and slower, and finally ceasing before the heart stopped beating. At the autopsy the cardiac wound was found to be one-half inch long; it passed into the right ventricle one and one-half inches below the pulmonary valve and just to the right of the interventricular septum, and then through the septum into the left ventricle about 2 inches below the aortic ring. Both ventricles were hypertrophied and the mitral valves were badly diseased.

It is not our intention in this paper to enter exhaustively into the subject of wounds of the heart. When we reported our first case we presented a brief history of the development of cardiorrhaphy and analysed the 60 cases that were on record at that time. Later with Le Conte, we attempted to set down systematically the results of a study of the literature bearing upon the surgery of the pericardium and the heart. (*American Practice of Surgery, vol. vii.*) Here we shall confine ourselves mainly to the ideas that we have formed, concerning the diagnosis and the treatment of cardiac wounds, as the result of our brief experience.

In all of the cases cited above we were sure, or at least as sure as a surgeon should be, that a wound of the heart existed, but we were equally certain of the same diagnosis in several other cases of wound of the thorax in which exploration revealed no wound in the heart. In each of these instances of mistaken diagnosis the thoracic wall was penetrated over the heart, the patient was profoundly shocked, and there existed a hemopneumothorax. In two of these cases, cases of gunshot wound, the pericardium had been grazed and contused but not penetrated. In another case of gunshot wound the bullet lodged in the pericardium, which contained a few drams of blood, and the heart was contused. In two cases of stab wound the knife had passed down between the pericardium and the lung. In all of these cases the pericardium was incised in order to permit direct inspection of the heart. In two other cases of stab wound of the precordium in which the general phenomena of shock were so pronounced as to suggest the possibility of injury to the heart it was found that the knife had not entered the thoracic cavity. It will thus be seen that a wound in the precordium, even though penetrating, may not involve the heart. Further, the heart may be reached by a knife or a bullet which has passed through the skin of the axilla, back, or abdomen.

Nor can any conclusion as to the participation of the heart in a wound be drawn from the amount of external bleeding. The only really enormous external hemorrhage that we have seen resulting from a wound of the heart caused death within 45 minutes. The patient had been stabbed near the hospital, and we chanced to be in the Receiving Ward when she was admitted. There was a gash several inches long in the left chest, and through this, the hole in the heart could be seen. We immediately closed this hole with the undisinfected forefinger, but life was extinct before sutures could be inserted. In none of the cases of cardiorrhaphy was the blood, at the time of examination, issuing from the cutaneous wound in more than a trickle. This may be accounted for partly by the valvular nature of the tracts leading from the skin to the heart. It is impossible with a single thrust of a narrow bladed knife to create a channel from the skin to the heart which will remain straight. So soon as the patient lies down the thoracic skin glides upward for one or two inches, and the heart likewise ascends. If the pleural cavity is, at the same time, opened, the heart is displaced farther by the resulting pneumothorax. In all of our cases the wound in the heart was above the wound between the ribs, and in three the cutaneous wound was on a level with the interspace next above the one that had been penetrated, thus making the tract V-shaped. In two of these three cases, in one of which the pleural cavity was not opened, it was noticed that the wound in the heart was considerably higher than the cutaneous wound, hence we conclude that the heart is likely to ascend to a greater extent than the skin. In addition to the influence of this augulation of the tract made by the vulnerating instrument in retarding the outward escape of blood, external hemorrhage is apt to be insignificant, or perhaps even absent, because the blood finds one, and usually two, reservoirs, viz., the pericardial and pleural cavities, into which it may flow unhindered. Consequently a bleeding intercostal or internal mammary artery unassociated with a wound of the pericardium or the pleura may give rise to considerable external hemorrhage because, aside from the cellular tissue, there is no place in which the blood can accumulate, and a wound which involves the pericardium or the pleura may exsanguinate the patient without pouring blood through its external orifice. Apart from its effect in determining the amount of blood which appears on the exterior, this gliding of the tissue, resulting from change in posture, may become a matter of serious importance, from a medicolegal standpoint, to one who attempts to estimate the direction of the original wound.

In four of our cases the local signs of hemopneumothorax were in evidence, and in these cases the area of cardiac dulness was replaced by tympany. In one case, in which the pleura was not injured, the area of cardiac dulness was greatly enlarged. In all cases but one (Case V, in which the heart gave no audible evidence of its activity), the heart sounds were faint but distinct, and in none could any adventitious sound referable to the heart be heard. It may be that some of the bizarre bruits described as indicating a wound of the heart are due in reality to the noise occasioned by the passage of air through the wound in the thoracic wall. In Case I the garrulity of the thoracic wound could have been misinterpreted readily, if on auscultation the opening in the thorax had not been temporarily plugged. Subcutaneous emphysema, which was noted in four of our cases, likewise may interfere with satisfactory auscultation.

The general symptoms of shock and acute anæmia were pronounced in all of our cases. It is worthy of remark, however, that the pulse, although exceedingly weak and in two instances irregular, was 100 or below in three cases, 108 in another, and only 130 in the case with the highest count. In two instances the patient walked for some distance after the accident. Distention of the veins of the face, neck, and arms, indicating pressure on the auricles as the result of hemopericardium, was present in only one of our cases. This sign, combined with an increase in the area of cardiac dulness, is almost, but not quite, distinctive of a wound of the heart, since it may follow also a wound of the pericardium alone or a wound of the great vessels within the pericardium. External evidences of hemopericardium, however, are not often encountered, because in most instances the blood, even though prevented from flowing out through a valvular opening in the thoracic wall as fast as it flows from the heart, finds an unobstructed outlet into the pleural cavity, and, further, the air in the pleural cavity dislocates and extends over the heart, thus replacing the dulness by tympany. If, as in Case III of the present series, the channel left by the traumatizing agent is strongly augulated and the pleura is not injured the conditions are ideal for the development of the typical signs of hemopericardium and cardiac compression. Doubtless the X-ray would demonstrate an augmentation in the shadow cast by the heart, owing to the accumulation of blood about it, in every case, for the pericardium always contains a large quantity of blood, even when this blood is not under sufficient tension to embarrass noticeably the venous flow to the auricles, but to make a roentgenologic examination in such an emergency would very rarely be for the patient's best interests. Aside from the signs of hemopericardium and cardiac compression, which, when following a penetrating injury capable of reaching the mediastinum, always indicate involvement of the pericardium or the heart, there is nothing to render a diagnosis of a wound of these structures certain except direct palpation or inspection.

In our earlier cases we disinfected the skin with soap and water, alcohol, and bichlorid of mercury, which method consumes too much time if done thoroughly and is unreliable if done hurriedly. Much more rapid and certain is painting the skin with strong tincture of iodin. After disinfecting the skin we have excised the external orifice of the wound, and then determined whether or not it entered the thorax by digital examination. If the finger passed into the thorax we endeavored to feel, as others have done, the opening in the pericardium, without, however, success, except in the case mentioned above in which death occurred before the heart could be sutured. Failing to discover the pericardial opening in this way we have made a chondro-cutaneous flap of sufficient size to uncover, when turned back, a large area of the pericardium, whereupon the opening in this membrane could be seen and felt without difficulty.

The size and shape of this chondroplastic flap we have varied according to the situation of the external wound and the amount of room necessary to expose and suture the wound in the heart. When the lung was collapsed the flap was made rapidly by cutting through all the tissues, including the costal cartilages, with a sharp, heavy-bladed knife, and then fracturing the cartilages corresponding to the base of the flap by reflecting the flap forcibly, to the left in three cases, to the right in one. So long as there is a pneumothorax it probably makes little difference in which of these directions the flap is turned, and one may be guided by the location of the external wound. If the pleura has not been injured, however, it is of the greatest importance to preserve that membrane intact, and this can be done best by turning the flap to the left, as described in Case III, in which a wide exposure was obtained easily and quickly by pushing back the unopened pleura from the pericardium. Resection of the sternum, we believe, will rarely be indicated, if we dare venture an opinion from the comparative facility with which we were able to suture a wound in the right auricle in this case (Case III) after reflecting the costal cartilages alone. If the external wound were to the right of the sternum and the right pleura were opened one would make the flap in the right instead of in the left chest.

After turning back the flap in the thoracic wall we have enlarged the pericardial opening in the axis of the heart, and explored the heart by palpation. We have never been able to see the wound in the heart, because of the copious hemorrhage, before it was discovered with the finger. Inspection was useless until the bleeding had been controlled temporarily by digital compression and the blood removed by sponging. Although we have always found the wound in the heart quickly, this is not always possible. Some years ago we watched one of Philadelphia's most skilful surgeons hunt for a number of minutes after the heart had been exposed before the wound was located, and there are several cases on record in which the operator searched vainly for a wound which autopsy revealed to exist.

In all of our cases the blood spurted continuously from the heart, and in Case II it was noted that the spurting was accentuated during diastole. In three instances the finger was kept on or in the cardiac wound until a suture could be inserted. This suture was then used as a tractor while the remaining portion of the wound was closed. In Cases II and V the wound was approximated with rat-toothed forceps during the suturing; this greatly facilitated the operation, and there was no tendency to tearing of the muscle as has been observed by other surgeons, but in Case V the pulsations of the heart fell from 108 to 52 and the patient ceased breathing for a short time, possibly as the result of the greater firmness with which the heart was held by the forceps as compared with a suture tractor. In Case II, however, the cardiac pulsations remained unchanged despite the use of forceps. Here we may call attention to the behavior of the pulse during operation in the other cases. In Case I it became very rapid and continued irregular; in Case III, in which the typical symptoms of cardiac compression were in evidence, it fell, as soon as the pericardium was opened, from 130 to 80 and became regular; in Case IV it increased from 90 to 100.

A continuous suture was employed in all cases, because it can be applied more quickly than interrupted sutures, and because it presents fewer knots on the surface of the heart, and less opportunity for leakage between the points of insertion. The needle was passed deeply without reference to systole or diastole, and in Case III (wound of the right auricle) must have penetrated the endocardium. Silk was used in the first two cases, and in one of these gave rise to a sinus through which the silk was discharged. In the remaining cases catgut was used. The longest wound in the heart was one inch, and to close this a continuous suture of seven insertions was necessary. In three instances additional sutures were needed to control the bleeding, once because of spurting from the needle punctures (Cases III, wound of the right auricle), once (Case IV) to tie a large branch of the coronary which ran into the wound, and once (Case I) to tie the descending branch of the left coronary close to its origin, where it had been accidentally wounded by the needle. This case of ligation of the left descending coronary artery is of considerable importance in view of the statements of some anatomists and physiologists regarding the fatal effect of suspension of its function. So far as we know this artery has been tied four times in the human being during cardiorrhaphy. Vince's patient died on the second day of pneumonia, Cappelen's on the second day of pyopericardium, Pagenstecher's on the fifth day of empyema and pericarditis. Our patient recovered and was apparently not inconvenienced by the obliteration of his coronary artery. At autopsy, however, five years after the accident, it was found that the wall of the left ventricle was the seat of interstitial myocarditis and in one place near the apex greatly thinned. In all of our cases we found a large quantity of clotted blood in the pericardial sac behind the heart. This clot was scooped out with the fingers and any remaining fluid blood removed with sponges.

In the first case we drained the pericardial cavity with gauze; purulent pericarditis followed. In the other four cases the pericardium was closed without drainage; two of the patients recovered without empyema of the pericardium; one died in one hour; and one died in 41 hours, the pericardium containing large masses of thick custard-like fibrin, which could not have been removed by drainage, and a comparatively small amount of pus. Unless forced to change our present views we shall not, if we have an opportunity to perform another cardiorrhaphy, drain the pericardial sac. Drainage does not prevent infection, indeed a drain favors infection, especially if the heat strikes against the material employed. Some operators, instead of placing a drain in the pericardial sac, have left the lower part of the pericardial wound open, and inserted a drain down to the opening. This may prevent the irritation and the consequent exudation resulting from the friction between the heart and the drain, but will not prevent the passage of air through the hole in the thoracic wall on its way to and from the pleural cavity when there is a pneumothorax, *i.e.,* in 95 per cent. of the cases. If the pericardium is closed completely and pus later accumulates in the pericardial sac drainage is of course indicated.

In two of our cases a wound of the lung was seen, but, because of the absence of bleeding, was not sutured. Drainage of the pleural cavity was instituted in the four cases in which there was a pneumothorax. In the three in which the patients survived long enough for suppuration to occur empyema developed. At present we should not drain the pleural cavity. We should employ the Auer-Meltzer insufflation apparatus during the operation, remove all the blood from the pleural cavity, and close the thorax completely; or if the insufflation apparatus was not at hand, close the thorax completely and withdraw the air from the pleural cavity by aspiration. The only discernible objection to this course is the possibility that distention of or suction upon the lung might renew or increase the bleeding from a wound in the lung. The importance of an air free pleural cavity, however, cannot be overestimated. The large volume of air existing between a collapsed lung and the thoracic wall contains a great number of bacteria, and unless this air is removed the bacteria settle on the pleura and give rise to infection. In a recent case of exploratory thoracotomy for a stab wound of the lung, the wound in the lung and in the thoracic wall was closed, and as much air as possible aspirated from the pleural sac; recovery followed without empyema.

ANEURISMORRHAPHY

TWO CASES OF ANEURISM TREATED BY MATAS' METHODS *

BY GEO. TULLY VAUGHAN, M.D.,
OF WASHINGTON, D. C.,
Professor of Surgery in Georgetown University.

It has been well said that Matas' operation for aneurism is the most important method for treating this disease which has been devised since Hunter in 1785 improved on the methods existing previous to his time by giving to the world "Hunter's operation."

In the wonderful progress which has been made in the surgery of the blood-vessels it was inevitable that some better way would be worked out, some way which would diminish the high mortality which characterized the older operations, and Matas struck that way when he operated in 1888 on a brachial aneurism by intrasaccular suture. Since that time, owing to the improvements in asepsis, skill and greater knowledge of the possibilities of vascular surgery, but especially to the work of Matas, the mortality has been reduced, for example, in operations on aneurisms of the subclavian artery, from 73 to 16 per cent. For aneurisms of the extremities we now have reliable and reasonably efficient methods of operation, but for those of the neck and great cavities of the body the means are yet inadequate and unsatisfactory. Whether the future will bring a successful and reliable method of treating aortic aneurisms in the shape of gradual occlusion by Halsted's bands or the resection of the aneurism and the implantation of a section of sound aorta from cold storage or otherwise, or some other yet unknown method, time alone can tell.

I wish to add two cases to the number of those treated by the Matas methods. In Case I it became necessary to change a contemplated reconstructive aneurismorrhaphy into one of

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the obliterative kind combined with an Anel ligation, on account of the impossibility of controlling the blood in the sac.

CASE I.—*Left iliofemoral fusiform aneurism; obliterative method, with ligation of the external iliac artery. Recovery. Death later.* S. McC., white male, aged twenty-nine years, nativity, Nebraska, occupation, laborer and soldier, inmate of the Government Hospital for the Insane, had the following history:

He deserted from the army and was arrested and sent to prison, where he developed dementia præcox and was sent to the Government Hospital for the Insane, August 30, 1906.

The aneurism was first noticed the following November. Previous to its discovery the patient had complained of pain along the inner side of the ankle, the calf of the leg, and over the tumor. There was no history of injury, and he denied having had syphilis but confessed to the free use of alcohol and tobacco. The patient was a medium small, well built and fairly well nourished white man with brown hair, blue eyes and a dull, somewhat depressed facial expression. The apex beat of the heart was displaced slightly to the left of the mammary line. There was a marked systolic murmur heard with greatest intensity at the apex, transmitted toward the axilla and also heard at the angle of the scapula. There was also an aortic, diastolic murmur of nearly the same degree of intensity. Pulse regular, 86 to the minute. A swelling 3 inches long and one and a half inches in width, was noticed in the left groin. There was an expansile pulsation and distinct bruit. Antisyphilitic treatment was tried without benefit, the aneurism was enlarging and it was decided to do Matas' operation on him. Under ether anæsthesia, December 19, 1906, the aneurism and artery above and below were exposed by an incision extending along the femoral artery upward across Poupart's ligament, then outward to the outer side of the inguinal canal, cutting through the muscles and stripping up the peritoneum until the external iliac was exposed as high as the bifurcation of the common iliac. The aneurism was about two inches long, irregularly fusiform in shape and extended above and below Poupart's ligament. The iliofemoral vein was closely adherent to the inner side of the aneurism—too close to dissect free. The artery was clasped above and below by rubber padded forceps. This stopped pulsation but on opening the sac, red blood flowed out, not in jets, but in a free and steady stream. Attempts were made to control this flow by pressure beneath, and to the inner and outer sides, thinking it might come from a collateral branch, but without effect. So the walls of the sac were sutured together and then turned in by a second row of catgut sutures. The external iliac artery was ligated with kangaroo tendon about one and one-half inches above the sac, and the wound was closed. No pulsation in the arteries of the foot could be felt at the close of the operation. The entire extremity was wrapped in cotton and the foot elevated. The leg and foot kept warm but no pulsation could be felt until fifteen days after the operation (January 3) when it was felt in both tibials at the foot. The patient made an uneventful recovery from the operation but died about 3 months later (April 9) from disease of the heart. Through the courtesy of Dr. Wm. A. White I was able to get a report of the necropsy which is given below. It will be noted that another aneurism was discovered, situated on the superior mesenteric artery.

NECROPSY.—" *External Examination.*—The body is that of a white man, fairly well nourished. The skin is slightly jaundiced. There is a punctiform eruption of the face and neck. There is a large scar in the left iliac region, the result of an operation.

Internal Examination.—Inspection. Skull is broad in front; sutures persistent in frontal region. The skull is rather dense and thicker than the average. Dura is normal. There are pleuritic adhesions on the left side. There is an increase of pericardial fluid. The abdominal fluid is also much increased and is bile stained.

Dissection.—Thoracic Cavity: Lungs are œdematous and russet color. The posterior portion of the right shows some small hemorrhages. Right lung weighed 600 grams, left lung 660 grams.

Heart: Weight, 500 grams. Is much dilated. The tricuspid opening admits four fingers. The pulmonary valves are normal. The anterior wall of the right ventricle shows yellow patches, probably indicating some disease of the muscle. The aortic valves are almost destroyed by a warty endocarditis. Two of the valves are perforated and must have been useless. The mitral opening admits three fingers and shows very little disease.

Aorta: This vessel is rather small, its walls are thin, there is no arteriosclerosis; the only abnormal appearance seen is a whitish deposit in the intima, probably a fatty infiltration. The lesion is situated in the thoracic and abdominal portions of the vessels. On the superior mesenteric artery at the origin of its principal branches is a small sacculated aneurism about 1½ inches in general diameter. This aneurism is filled with clots, but the circulation has been kept up by the open lumen of the vessel posteriorly, and all the branches are pervious.

The aneurism which has been the seat of operation was examined and at the site of the operation it was extremely difficult to trace the vessel, so obliterated had it been by inflammatory changes. The vessel from the ligature to the origin of the internal iliac artery was filled by a tough partially adherent clot. The demonstration of the collateral circulation was too difficult, and was not done.

Abdominal Cavity.—Liver: Weight, 2160 grams. This organ is enlarged and shows a marked nutmeg appearance, with an irregular distribution of the blood. (Acute stage of passive hyperæmia). The gall-bladder contains about 30 c.c. of thick dark ropy bile.

Kidneys: Are œdematous. The cortex is wide and relatively paler than the pyramids. The capsule adheres slightly leaving a few pits over the surface which are not easily explained. Both are in the same condition. Weight of left kidney 190 grams. Weight of right kidney 170 grams.

Spleen: Weight, 410 grams. It is much enlarged. The pulp is soft and full of blood, the result probably of infarctions. The organ is adherent to parts in its vicinity.

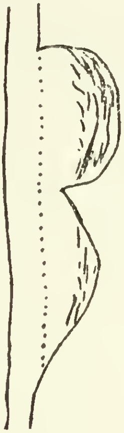
Cranial Cavity.—Brain: Weight, 1580 grams. Is rather pale. The arteries are not diseased. The right posterior communicating artery is large. The corresponding posterior cerebral is small. The anterior cerebral of the right side and the anterior cerebral of the left are large. Both efficient anterior cerebral arteries come from the same side and are distributed as usual. On the right side the posterior inferior cerebellar is absent, its place taken by the anterior inferior cerebellar.

Conclusion.—The absence of any arteriosclerosis and the presence of localized aneurismal dilatations of the aorta lead to the conclusion that the condition must have been due to syphilis. The liver was not scarred and there were no other signs of syphilis."

Case II.—*Popliteal aneurism. Right side. Reconstructive method. Recovery.* February 26, 1910. J. E., male, colored, forty years old, nativity, Virginia, laborer. Admitted to Emergency Hospital.

History.—Patient has had pain in the right knee for about one year but did not know the cause of the trouble. Examination revealed a swelling about the size of a hen's egg in the popliteal space, a little external to the median line, pulsating strongly—the pulsations being arrested by pressure on the femoral artery at the pelvis.

Fig. 1.



Side view: Dotted line indicates suture restoring artery to normal size.

Under morph. atrop. ether anæsthesia, an incision was made over the swelling, exposing the sac and the artery above. At the lower end of the sac a second aneurism was found, about half the size of the first, oblong and separated from it by a constriction (Fig. 1).

During the dissection the pulsation in the large sac suddenly ceased and on opening it, in addition to the old laminated clot which partially filled the sac, another clot of bright red color was found filling the sac and evidently the cause of the arrested pulsation. It had formed during the process of uncovering the vessels above and below in order that the blood current might be controlled during the operation of suturing the sac. The blood current was controlled by a rubber tube passed around the artery above and clamped with hæmostats, the sac was incised, the clots turned out and the cavity wiped clean. The walls were then turned in by continuous sutures of No. 1 chromic catgut as shown by the dotted line in Fig. 1, thus restoring the original lumen of the vessel.

A second row of sutures was added turning in an additional coat over the first. Blood was allowed to run through by relaxation of the rubber tube and as there was some leaking a third row of sutures was added along both sacs and a fourth row over the larger sac in order to dispose of its coats. Feeble pulsation in the artery below could be felt after the conclusion of the operation. Wound in skin closed with catgut. Patient was put to bed with leg wrapped in cotton and elevated. No pulsation could be felt in the foot.

Next day (27th) feeble pulsation could be felt in the dorsalis pedis artery and the patient was doing well.

February 28: Patient doing well, foot and leg warm but no pulsation could be felt in the foot or leg. No pain, only a slight feeling of numbness in the leg and foot.

March 5: First dressing—primary union. No pulsation in foot, but it is as warm as its fellow and the patient is quite comfortable.

March 13: Permitted to sit up in a chair; condition same.

March 19: Wound healed; condition of circulation same. Discharged, recovered.

When last heard from, about one year later, the patient was apparently well.

ARTERIOVENOUS ANASTOMOSIS FOR THREATENED GANGRENE OF THE FOOT.*

BY LEONARD FREEMAN, M.D.,

OF DENVER, COLO.

Professor of Surgery in the Medical Department of the University of Colorado.

REVERSAL of the circulation has been attempted in but 50 or 60 published cases of incipient or fully developed gangrene of the extremities, and the results apparently have been so conflicting that the value of the operation is still under discussion. The following case is reported with the idea of adding to the clinical evidence from which final conclusions must largely be drawn.

About two years ago a Russian Jew, aged thirty-nine, developed "Raynaud's disease." The left hand was cold, numb, cyanotic and painful, and finally the tips of several fingers became gangrenous. Without treatment the difficulty gradually disappeared, leaving a few smooth, white scars only.

Six months later severe pain was felt in the calf of the right leg, soon shifting to the vicinity of the large toe; and during the next year or so extensive gangrene of the foot slowly appeared, which finally necessitated amputation of the leg below the knee on July 6, 1912.

Recovery was prompt; but in the course of three or four months, to the consternation of the patient, similar trouble began in the left foot. On December 26, 1912, the foot was cold, numb and cyanotic, and no arterial pulsation could be detected. Gangrene, with ulcerations about the nails, was just beginning at the tips of the first and second toes, shading off toward their bases in a slight bluish discoloration, without even a suggestion of a line of demarcation. There was continuous and exhausting pain.

Through the newspapers the patient had heard of reversal of the circulation in cases like his own, and insisted upon having this done before consenting to an amputation. Although faith in the procedure was lacking, it was decided to try it, on the principle that if the chance of success was small the danger of doing harm was equally so.

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On December 28, 1912, assisted by Dr. O. M. Shere, a lateral anastomosis was done between the femoral artery and vein, about the middle of the thigh, the vein being exposed peripherally, as far as practicable, and its lateral branches tied. In order to prevent the blood from returning immediately toward the trunk, the vein was proximally ligated, but the artery was not disturbed, thus preserving any remaining circulation which might exist.

For lack of finer material, a number 12 needle with number 16 silk thread were employed. These were soaked in liquid vaseline, which was also smeared liberally over the exposed tissues. After isolating sections of the vessels with rubber-covered clamps and removing the adventitia, oval openings were snipped from their corresponding sides with iridectomy-scissors, the blood washed out with normal salt solution in a medicine-dropper, and the anastomosis completed by a sort of reversed gastro-enterostomy stitch, which turned the edges of the intima outward, leaving a smooth surface internally, one or two extra stitches being required when the clamps were removed. The blood immediately passed in a full stream through the opening, a strong pulsation being seen and felt in both artery and vein as far as they could be followed.

On the next morning, somewhat to our surprise, the skin of the foot, which previously had been cold and cyanotic, was warm and pinkish in color, although the veins of the leg were not distended and no pulsation could be felt anywhere. The pain and numbness had largely disappeared and it was plainly evident that a marked change for the better had occurred. The patient stated that he could feel the warmth and sensation returning a few hours after the operation.

This improvement lasted for several weeks, although it became gradually less manifest as time progressed. A distinct line of demarcation rapidly formed at the base of the large toe and somewhat lower down on the second toe. Altogether it seemed likely that a satisfactory result might be obtained; but to our disappointment the old condition slowly returned, the line of demarcation disappearing and the gangrene progressing on to the dorsum of the foot, requiring removal of the leg below the knee on February 26, 1913, eight and one-half weeks after the original operation.

Before amputating, an incision was made over the anastomosis in order to observe its condition, it being argued that if blood was still passing into the vein a lower amputation might be done than if the opening was obliterated. On making a slit into the vein blood flowed freely from below, but the anastomosis was evidently closed. A soft dark clot, about the size of a small bean was found adherent to the anastomotic site by its upper extremity. An examination of this, made by Dr. Phillip Hillkowitz, revealed " an inner core consisting of red cells and leucocytes " surrounded by " a broad zone of young fibroblasts imbedded in a structureless stroma," showing that " the clot had been formed several weeks before removal." The character of this thrombus hence pointed to a comparatively recent origin, and indicated that the circulation through the anastomosis perhaps had been efficient for a time at least.

A careful dissection of the amputated leg, made by Dr. Shere, showed marked sclerosis of the arteries and obliteration of their lumina.

The further progress of the case was uneventful.

Between 50 and 60 arteriovenous anastomoses for established or threatened gangrene have been reported, the former operations merely being done in the questionable expectation of saving more of the limb than ordinarily would be possible. The great majority of these cases have terminated unfavorably, in that the circulation of the affected part underwent no immediate improvement, or the improvement was but temporary.

This lack of success has been attributed to a variety of causes—to an improper selection of cases, to defective technic, to immediate or secondary thrombosis, to lack of post-operative care, etc.,—but most surgeons prefer to believe that it is due to inherent deficiencies in the operation itself. Among the apparently successful cases, a number, when considered from an unbiased standpoint, are open to serious question, some being unconvincing and others having been reported too soon to be of value. Bernheim (ANN. SURG., Feb., 1912) places the apparent successes at 30 per cent.; but in the estimation of many others this is much too high, and the real successes, if any, are probably far below this.

It has been demonstrated with reasonable certainty that a limited quantity of arterial blood may penetrate to the terminal ramifications of the femoral vein after its junction with the artery (2 to 4 per cent. according to Rothmann). It hardly seems justifiable, however, to assume that it will continue to do so, at least in adequate amount, after the numerous lateral anastomotic veins have had time to become dilated, thus carrying the blood back toward the trunk by a much easier and shorter route. Nevertheless, it might be imagined that in certain individuals these veins are unusually few in number or small in calibre, and that under such conditions a reversal of the circulation would be satisfactory in its ultimate as well as in its immediate effects. In order to reduce the number of these lateral veins, it has been suggested that as many as possible be tied at the time of the operation, as was done in the case just reported. This is of course proper enough as far as it goes; but one cannot tie them all, and it is questionable if the obliteration of a few is of sufficient importance to justify the extra time and manipulation required.

It is doubtful if the successful cases reported in connection with the upper extremities (Bernheim, *J. A. M. A.,* Feb., 1913, p. 360; Wieting, *Zent. f. Chir.,* No. 12, 1913, p. 450) are of much value, because spontaneous recovery from beginning gangrene of the fingers is not of uncommon occurrence. In fact, in the case just described, it will be recalled that without treatment of any sort the disappearance of a marked lesion of this kind was so complete that only a few smooth, white scars remained. Similar recoveries have also been seen by the writer and by many others in connection with beginning gangrene of the toes, especially under the favorable influence of rest, posture, improved nutrition, and stimulation of the circulation, which, it should be remembered, are likewise taken advantage of following arteriovenous anastomosis.

In estimating the worth of the operation it should also be borne in mind that some of the apparently beneficial effects may be due merely to obstruction of the venous circulation. For instance, von Oppel tied the popliteal vein in a case of threatened gangrene of the foot, the procedure being shortly followed by a return of warmth, color and sensation to the affected part, together with the disappearance of the pain which had previously existed—phenomena which, according to Davier, most certainly indicate the success of an arteriovenous anastomosis! In this connection Moskowicz says (*Zent. f. Chir.*, No. 14, 1913, p. 507), "It is more probable that Wieting's anastomosis between the femoral artery and vein owes its effectiveness more to the passive hyperæmia from ligation of the vein than to an actual reversal of the circulation."

From theoretical considerations and from the results so far obtained in arteriovenous anastomosis for threatened gangrene of the extremities, the following conclusions may, perhaps, fairly be drawn:

1. Although the procedure is justifiable in a few well-selected cases, it seldom has been followed by success, and even then its real value may be questioned, owing to the fact that spontaneous recoveries occasionally occur—with as much frequency, possibly, as do operative successes.

2. Owing to the uncertainty of the value of the operation, one should at least endeavor to do as little harm as possible. Hence, from this point of view, it is better to do a side-to-side anastomosis, or to implant the distal end of the vein into the side of the artery, rather than to unite the two vessels end-to-end; thus preserving to the limb its remaining arterial circulation, however little that may be.

3. According to our present knowledge, operations upon the upper extremities should be considered with reservation, owing to the comparative frequency of spontaneous recoveries.

CONTRIBUTION TO THE STUDY OF SARCOMA OF THE FEMUR.

PERIOSTEAL ROUND-CELLED SARCOMA OF THE FEMUR, INVOLVING TWO-THIRDS OF THE SHAFT, WITH VERY EXTENSIVE MULTIPLE METASTASES—APPARENT CURE BY THE MIXED TOXINS OF ERYSIPELAS AND BACILLUS PRODIGIOSUS. WELL 10½ YEARS, WHEN A MALIGNANT TUMOR (SARCOMA AND EPITHELIOMA) DEVELOPED IN THE THIGH AT THE SITE OF AN OLD X-RAY DERMATITIS.*

BY WILLIAM B. COLEY, M.D.,
OF NEW YORK,
Professor of Clinical Surgery, Cornell University Medical School, New York.

THE patient who is the subject of this paper was shown before the New York Surgical Society on a number of occasions. A full report of the condition up to May, 1912, will be found in the November, 1912, number of the ANNALS OF SURGERY, p. 787. The case, at the time of publication, was, as far as I know, entirely unique, being the only one on record of a periosteal round-celled sarcoma of the femur, with metastases, cured by any method of treatment. Of 68 cases of periosteal sarcoma of the femur collected by Butlin, treated either by amputation at the hip-joint or just below the trochanter, only one was permanently cured (well eight years), and in this case there were no metastases. Since the earlier report of my case developments have occurred which render it of still greater interest.

When the patient came under my care in February, 1902, for sarcoma, periosteal, round-celled, involving two-thirds of the shaft (the diagnosis confirmed by microscopical examination by Dr. E. K. Dunham, Professor of Pathology of the Bellevue University Medical School), the involvement of the femur was so great that I advised immediate hip-joint amputation, which was refused by the patient. X-ray treatment was administered for a prolonged period, during which an extensive metastatic tumor occurred in the left pectoral region. A little later, a tumor the size of a child's head developed in the iliolumbar region, involving the ilium. The tumor of the pectoral region was partially removed and X-ray treatments for a short time after the operation were given. No X-ray was applied to the large iliolumbar tumor.

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* Read before the American Surgical Association, May 7, 1913.

The toxins were given from February 12 to July 25, 1903, in doses ranging from .5 minim to 20 minims, 86 injections in all being given. The temperature rose to 103.5° F. As stated in the earlier history, the large iliolumbar tumor became almost completely broken down under two months' treatment with the toxins, and drainage was established by an incision made through the upper and posterior part of the ilium, and a large quantity of necrotic tissue evacuated. The patient went on to complete cure and remained well over ten years. Aside from the persistent dermatitis which followed the irritation from the X-ray, in the lower and anterior portion of the thigh, there was also some slight dermatitis in the pectoral region. At the time the patient was shown before the Surgical Society, in April, 1912, a small tumor, the size of an olive, had just developed in the pectoral region at the site of the dermatitis described. This was removed under cocaine the following week and pronounced epithelioma by Dr. Jas. Ewing, Professor of Pathology of Cornell University Medical School, without any connection whatever with the original sarcoma. The patient remained well during the summer, but in the latter part of October, 1912, when I again saw him, I found a very remarkable change had taken place in the old dermatitis in the lower part of the thigh. There was a very large ulcerating area, fully 10 inches in diameter, which showed unmistakable evidence of malignant degeneration, the discharge having the foul odor characteristic of epithelioma. The ulceration rapidly extended in all directions until it covered an area fully 12 x 12 inches and was constantly increasing in thickness. The general health of the patient also became greatly deteriorated. The appearance of the surface of the tumor was extremely characteristic of the tumors which I have seen originate in old X-ray burns. The disease in this case apparently started in the skin and subsequently involved the deeper layers, instead of beginning in the bone and spreading externally. This fact was distinctly shown by the X-ray photograph. The structure of the tumor proved to be very unusual, and different diagnoses were made by several pathologists, although the tumor was regarded by all as highly malignant. I am fortunate in having been able to obtain the following very clear and full report from Dr. W. H. Welch, professor of pathology of John Hopkins University:

Examination of Fragments of Tumor for Dr. W. B. Coley (Nov. 27, 1912).—The specimen consists of several small irregular, rather ragged fragments of solid tissue, the largest being about 2 cm. long, 1.5 cm. broad and 0.6 cm. thick. Upon two of the pieces epidermis can be recognized along one margin.

The microscopical sections show a neoplasm composed of cells and stroma, the former predominating. Some of the sections show only the tumor tissue; others present upon the edge of the tumor an ulcerated surface covered with fibrin, leucocytes and red corpuscles, and two sets of section show cutaneous tissue covered by a thick layer of epidermis. In these last sections the subcutaneous tissues are occupied by the tumor, which has evidently invaded the corium from below and in places appears to have reached the epidermal layer.

The tumor is composed mainly of cells with, as a rule, rather scanty fibrous stroma. The cells vary in size and shape but spherical, oval and polyhedrical cells of rather larger size with large vesicular nuclei, containing nucleoli, and with abundant cytoplasm, predominate. There are also fusiform cells, often occurring in bundles, cells with irregular nuclei and with two, three or more nuclei are common. In some fields the cells are closely compacted, while in others there is more of delicately fibrillated or even coarsely fibrous connective tissue between the cells. There is no marked tendency to arrangement of the cells in nests or alveoli.

While considerable parts of the tumor show no evidence of degeneration or marked inflammatory infiltration, there are areas which are extensively invaded with polynuclear leucocytes and lymphocytes, and here the nuclei of the tumor cells often stain diffusely or show other evidences of regressive changes. In parts not thus invaded nuclear figures are numerous.

In the sections presenting a covering with skin, the deeper layers, corresponding to the subcutaneous tissue, show a sarcomatous growth of essentially the characters already described, but in most places extensively invaded with leucocytes.

In the dense fibrous tissue of the corium, in which sections of small hair follicles are numerous, there are scattered strands and islands of richly cellular tissue. The typical large tumor cells can occasionally be seen in these cellular foci, but many of the cells are smaller and appear to lie in and around blood and lymph capillaries, the endothelium of which is swollen and proliferating. The majority of cells in these foci appear to be lymphocytes and plasma cells.

The epidermis is moderately infiltrated with wandering leucocytes. There is some thickening and down growth of the interpapillary processes of epithelium, and over an area of about one millimetre in extent in the sections, where the cellular infiltration of the corium is most extensive beneath the epidermis, there is such an irregular and considerable down growth of the epidermal cells as to suggest an epitheliomatous growth.

Diagnosis.—Large round-celled sarcoma.

There is no objection also to the designation of mixed-celled sarcoma, although the round-celled type predominates. The type is like that of many periosteal sarcomata, as is indicated by the large cells with irregular and multiple nuclei. The specimen is evidently from metastases invading the skin, if, as I understand from the clinical history, the primary growth was of the periosteum.

While much of the tumor shows the ordinary appearances of sarcoma, it is interesting to note the considerable areas undergoing degeneration and especially the extensive infiltrations with leucocytes.

The interpretation of the lesions of the corium and epidermis over the subcutaneous sarcoma is not so obvious. While occasionally cells resembling the sarcoma cells are seen in the cellular foci of the corium, especially those nearest the subcutaneous growth, many of these foci appear to consist of capillaries with swollen and proliferating endothelium and of accumulations of lymphoid and plasma cells, so that these lesions are probably best interpreted as in the main of a chronic inflammatory character, that is a dermatitis.

The question as to the interpretation of an apparently invasive down growth of epidermal cells, as described above, can hardly be positively answered. Inasmuch as atypical down growths of cutaneous epithelium with inflammations and ulcers of the skin are common and sometimes extensive, it is possible that this is the correct interpretation of the lesion in this case. Still I should not be willing positively to exclude the possibility of a true epitheliomatous growth superimposed upon the sarcoma. The main growth, however, is, as described, a round-celled sarcoma of the type most frequently originating in the periosteum or endosteum (peripheral or central sarcoma of bone).

Pathologist, William H. Welch.

Taken from Dr. Welch's letter dated December 23, 1912:

"I spoke to Dr. Halsted about your specimen. He was extremely interested, and thought that the evidence for efficacy of the treatment by your method was strikingly manifested by the history of the case, and so it seems to me. To have brought about the disappearance of the tumor and to have kept the growth in check for ten years, and then to have the same (presumably) type of growth reappear in the original site and this a markedly malignant type of sarcoma, is a unique chain of events, which is perhaps more convincing than the disappearance of a tumor without a later return. I have not expressed this very clearly I fear, but you will see the point as it impressed Halsted.

(Signed) WILLIAM H. WELCH."

(Professor of Pathology at Johns Hopkins University, Baltimore.)

I also obtained reports on the tissue removed, from Dr. Jas. Ewing, professor of pathology, Cornell University Med. School, and Dr. W. C. Clark, pathologist at the General Memorial Hospital. Their reports are as follows:

"The tissue in the A. G. case shows intact epithelial lining; extensive œdema in many pockets. The derma is the seat of productive new growth of tissue which, in many places, is composed of cellular and mucoid material. Many spindle- and star-shaped cells—large or huge hyperchromatic nuclei. Such areas grade insensibly into new cellular tissue in which the structure resembles that of large spindle-celled sarcoma. Here the cells are very numerous, large nuclei hyperchromatic, blood-vessels numerous. Parts of these areas are traversed by numerous elongated blood sinuses lined by spindle tumor cells, and the whole process suggests great potentialities of independent growth. To call it sarcoma, seems to me to dismiss it inadequately, but the clinical course may very well be that of spindle-celled sarcoma.

(Signed) J. Ewing."

Dr. William C. Clark's report reads as follows:

Tumor of skin of leg, December 21, 1912. Patient, A. G.

Gross examination shows a mass projecting slightly above surrounding skin level. This mass is sharply outlined, measures a cm. in diameter, it is roughened and much firmer in consistency than the surrounding tissues.

On cut section the tumor is found to be sharply outlined, is oval and measures 6 cm. in depth.

Microscopic examination shows that the tumor is a part of the true skin, that is, the epithelial structures of the true skin become a part of the tumor.

The tumor proper consists of large epithelial cells of the squamous variety with relatively large deeply staining nuclei. This is especially true of the cells on the deeper part of the tumor.

The epithelial cells of the central and superficial parts of the tumor are pale, with pale nuclei. At one point in the epithelium there is a small cyst. The periphery of the tumor in contact with the deeper tissues is made up of rounded masses, and columns of epithelial cells, but the general outline of the tumor is sharp, clean cut and is not infiltrating the surrounding tissues. There is an extensive round-celled infiltration. There is no sign of ulceration.

Diagnosis.—Epithelioma of the basal-cell type.

I advised amputation of the leg as soon as the diagnosis was made, but failed to get the patient's consent until January 2, 1913. He was anxious to have the toxins tried again, and they were administered regularly from November 18, to December 5, 1912, in doses ranging from .5 minim to 5 minims, 12 injections in all being given, with no apparent effect upon the progress of the disease. The surface of the tumor was also treated with large doses of very strong radium ointment, principally in the hope of overcoming the very foul odor from the discharges. No effect was noted, however.

He also had one injection of colloidal copper. In view of the patient's failing general health and weak condition, all treatment was abandoned.

Later History.—After the case was reported before the Surgical Society, December 11, 1912, the patient's general condition continually grew worse, and his consent to have the leg sacrificed was finally obtained. On January 2, 1913, I amputated under nitrous oxide gas and oxygen. The entire operation, including the closing of the wound, took 13 minutes. Although the larger nerves were not cocainized, he showed very little shock from the operation, no nausea or vomiting and made a very good recovery. The limb was taken to the laboratory of Cornell Medical School and Dr. Ewing made a further study of the tumor. His second report reads as follows:

Case of G., April 23, 1913. Tumor of femur. Specimen consists of a leg amputated through the upper third of the thigh. The skin is absent over the anterior and lateral surfaces of the region of the knee-joint for a distance of 20 cm., and in its place is a hard nodular growth. pale in color and spotted here and there with ecchymotic areas varying in size from a pin point to 4 and 5 cm. in diameter, and small ulcerating areas (.5 to 1.5 cm.) containing white cheesy-like material.

On vertical section the tendon and lower portion of the rectus femoris, to within 2 cm. of the patella, is replaced by a tumor mass for a distance of 14 cm. This mass appears quite separate from the periosteum of the femur, a layer of fat being interposed. At its widest point it measures 6 cm. Its upper surface is covered with skin and subcutaneous fat, but the remaining portion has broken through the integument and produces an ulcerating area which is seen on the surface of the limb. The surface of this mass is smooth, white and glistening.

At the point of amputation, the diameter of the femur is not increased and the compact bone appears to be normal; the medullary cavity contains a reddish-brown marrow. In the lower third of the bone, it measures about 7 cm. in diameter and the medullary cavity has entirely disappeared; the compact bone is atrophied, in places being only a shell. Where the normal marrow cavity ends, there is a small deposit of cancellous bone; just below this, there are two bone cysts, measuring .5 and 1.5 cm. in diameter and lined with a glistening membrane. Extending from the cancellous bone, posterior to the cysts, is a mass of ivory-like compact bone which takes in the entire diameter of the femur just below the cysts. Below this compact bone is a sequestrum, 4.5 cm. in length, the remains of what appears to have been a part of the shaft of the femur; this lies in cancellous tissue. Just above this condyle in the medullary cavity is a well circumscribed tumor measuring 5 × 3 cm.

The cut surface is white and granular in appearance and cuts with considerable resistance; the edges are well marked and the tumor does not appear to infiltrate the surrounding tissue.

The cancellous tissue in the condyles appears normal. Patella shows osteoporosis. The head of the tibia shows atrophy of compact bone. Medullary cavity is normal, except for an area 5 cm. long by 3 cm. wide, in which the marrow appears to be denser than the surrounding tissue.

Microscopical.—The compact tumor measuring 5 × 3 cm. in the marrow cavity of the lower end of the femur, is an adult acanthoma (epithelioma). It is composed of compact masses of stratified squamous epithelium of adult type, with spines and pearls and many large, almost cystic areas of hornified material. The stroma is cellular connective.

The tumor in the rectus femoris is composed of many large and small polygonal and spindle tumor cells, with vesicular hyperchromatic nuclei and prominent nucleoli. These cells invade the muscle tissue in rows, small groups, and diffusely. Muscle cells undergo simple atrophy.

The origin and nature of this tumor, I am unable to determine. It appears to be of rapid growth and of recent date. Its structure would ordinarily be designated as sarcoma. I do not think it arises from the femur, since the underlying periosteum is intact and separated from the tumor by a layer of fat tissue. The sequelæ of the original process in the bone are probably to be found in the cysts, the areas of osteosclerosis, and the large sequestrum mentioned in the gross description. It is difficult to determine whether or not these gross lesions can be interpreted as the result of an arrested sarcoma. It would seem possible that they might result from an old osteomyelitis with formation of sequestrum, osteosclerosis and bone cysts.

The epithelioma in the medullary cavity may be interpreted as a metastasis from a lesion in the skin resulting from the X-ray, but no such tumor was recognized in the ulcerated surface of the amputated specimen. It is very probable that the tumor of the quadriceps was an extension from the peculiar process in the ulcerated superficial tissues and that it resulted from the long use of the X-ray.

One to two weeks after the operation the patient developed metastases in the lung and probably also the peritoneum, and died on January 16, 1913.

Blood Analyses.—The various blood counts in this case are of interest:

November 6, 1912: W. B. C. 15,000; hæmoglobin 70 per cent.

December 12, 1912: W. B. C. 20,000; R. B. C. 3,000,000; hæmoglobin 60 per cent.

December 19, 1912: Hæmoglobin 50 per cent.

December 28, 1912: Hæmoglobin 60 per cent.

January 2, 1913: Hæmoglobin 50 per cent.

January 11, 1913: Hæmoglobin 35 per cent.

January 14, 1913: Leucocytes 106,000; polynuclears 99.5 per cent.; mononuclears 0.51 per cent.

January 16, 1913: Hæmoglobin 25 per cent.

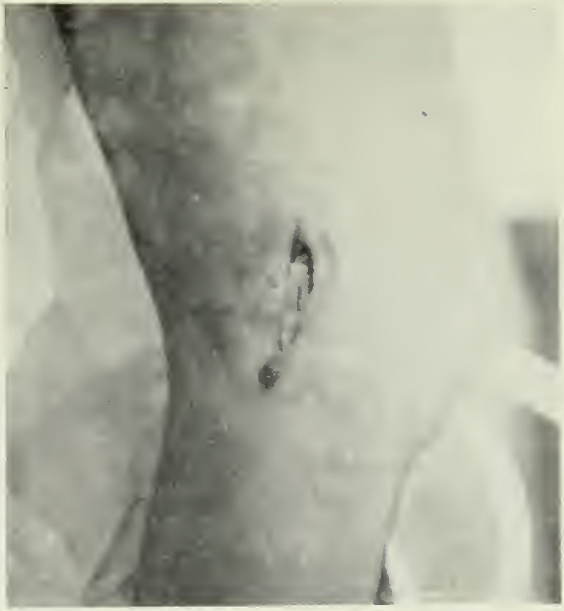
On consulting my records, I find an old report of a blood examination, dated May 5, 1902, at which time he was taking X-ray treatment for the periosteal sarcoma of the femur. The report reads as follows: Hæmoglobin 47 per cent.; red cells 3,300,000; white cells 11,100; lymphocytes 11 per cent.; polynuclear 69 per cent., of which 50 per cent. neutrophilic; mononuclear 10 per cent., disintegrating; eosinophiles 2 per cent., multinuclear; myelocytes (small) 8 per cent.

A careful study of the blood changes in bone carcinoma with metastases, has been recently made by Gordon R. Ward (*Lancet,* March 8, 1913, p. 676) based upon four cases. In these cases the hæmoglobin varied between 32 and 115 per cent., the white blood corpuscles in the four cases were 3700, 9000, 1080 and 15,000. The polynuclears varied between 48 and 53 per cent.

The facts in this case have been presented as clearly and judicially as possible; their interpretation will be left largely to the readers. It is unfortunate that the slide of the original specimen removed from the periosteal tumor of the femur in February, 1902, has not yet been found. In moving the laboratory of the General Memorial Hospital the index of the slides for this particular period was lost. Clinically and macroscopically, the appearance of the tumor was that of a periosteal tumor, involving two-thirds of the shaft of the femur, quite characteristic of sarcoma. A specimen was removed by a large exploratory incision and the diagnosis of small, round-celled sarcoma made by Dr. E. K. Dunham, director of the Carnegie Laboratory, and professor of pathology at Bellevue University Medical School, and by Dr. B. H. Buxton, Assistant Pathologist to the General Memorial Hospital. The subsequent history of the case, I believe, renders the loss of the slide unimportant, except for the purpose of making a comparison of the type of the tumor originally found, and the one that developed ten years later. The extensive multiple metastases which soon developed, confirm beyond question the diagnosis of malignant tumor.

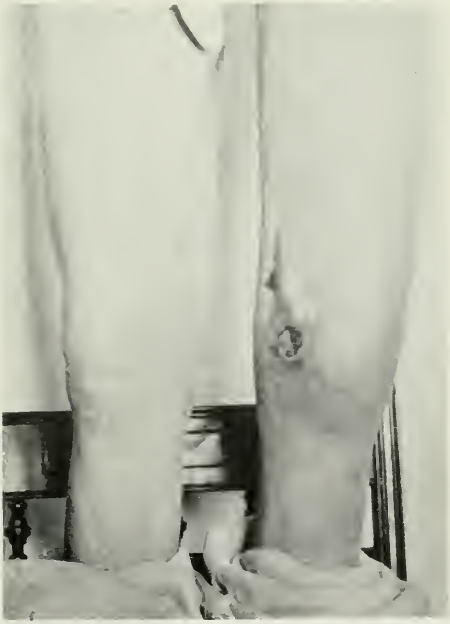
Conclusions.—My own conclusions after a careful study of all the clinical data in this case, together with the elaborate

Fig. 1.



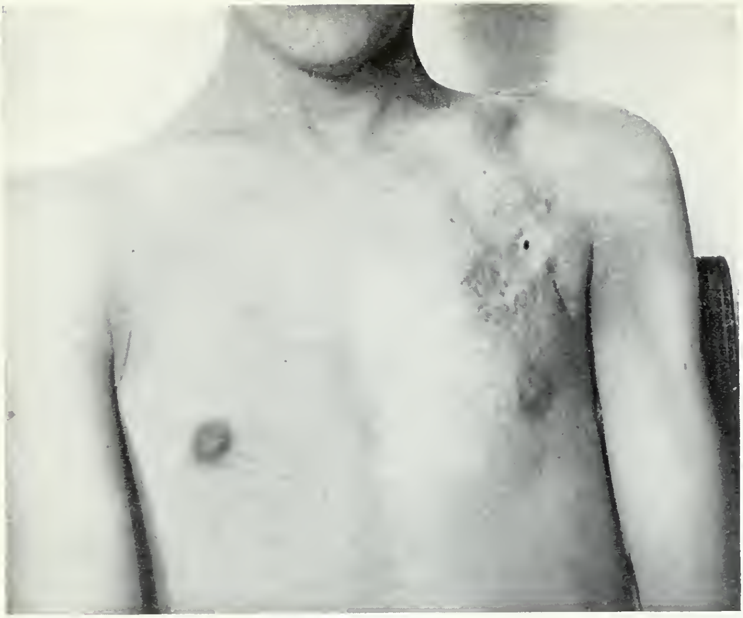
Sarcoma of left femur before treatment. Subperiosteal round-celled. Showing exploratory incision made in February, 1902. Under X-ray treatment developed extensive metastasis in left pectoral region and right iliolumbar region. Apparent cure by mixed toxins of erysipelas and bacillus prodigiosus. Patient well ten years later.

Fig. 2.



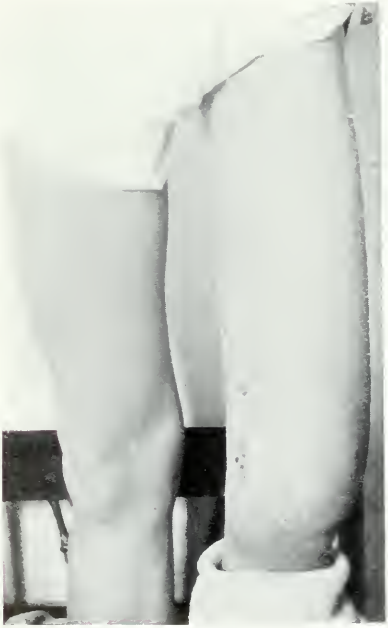
Sarcoma of femur, after six months' X-ray treatment.

FIG. 3.



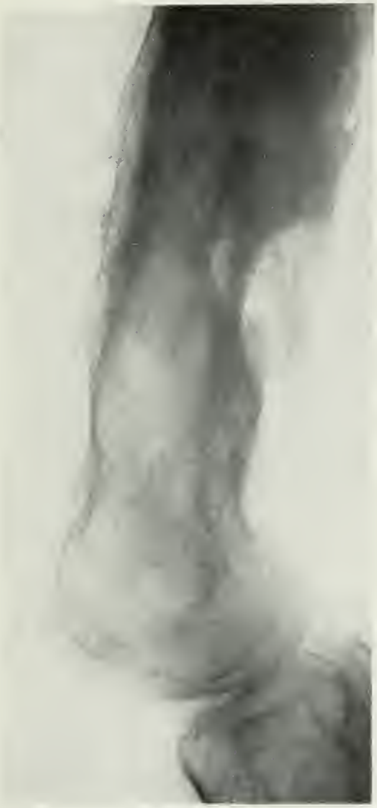
Sarcoma of femur. Metastasis in pectoral and lumbar regions. Showing dermatitis after X-ray treatment and site of epithelioma which developed ten years later.

FIG. 4.



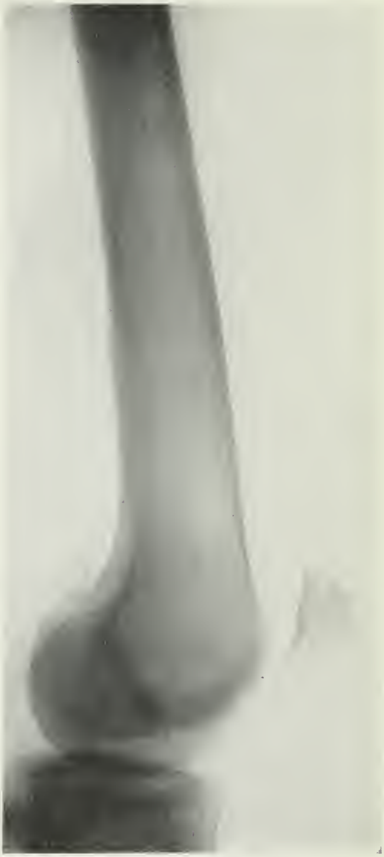
Appearance September, 1911.

FIG. 5*a*.



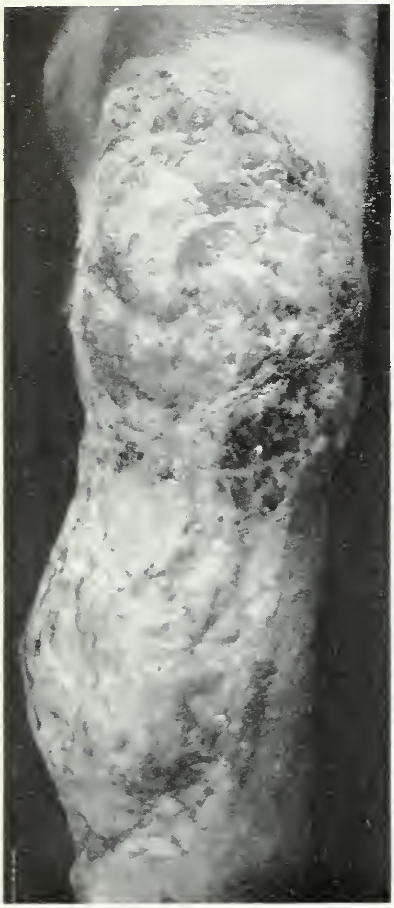
X-ray taken ten years after beginning of treatment, showing sequestrum and new formation of bone.

FIG. 5*b*.



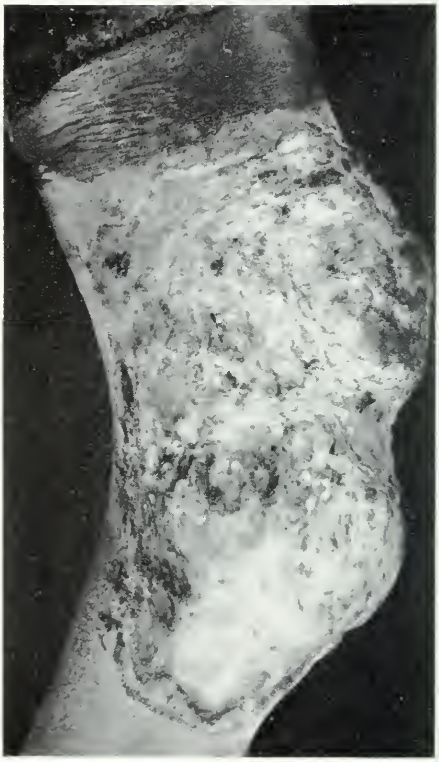
Sound femur.

Fig. 6.



November, 1912. Malignant tumor. Sarcoma and epithelioma at site of X-ray dermatitis, in thigh.

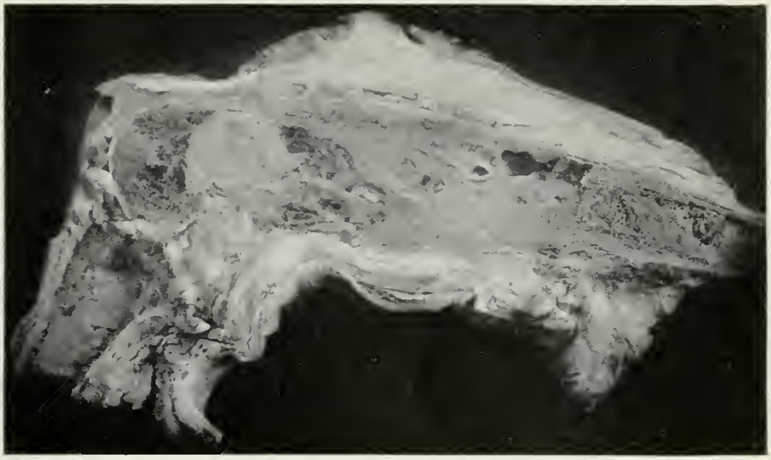
Fig. 7.



January 2, 1913. Showing rapid progress of disease in two months and appearance at time of amputation.

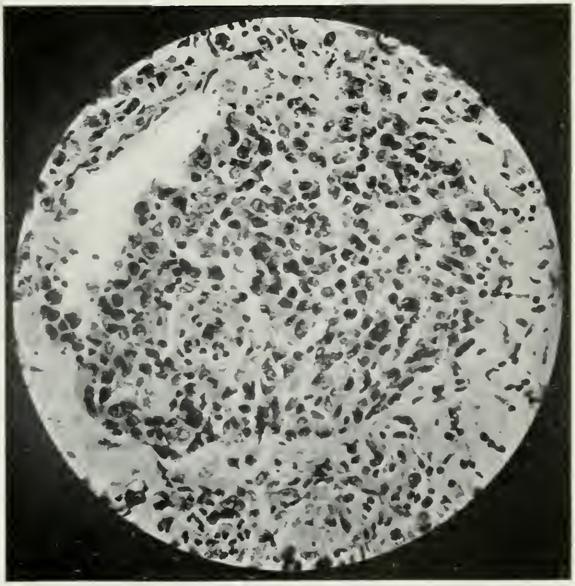
Fig. 8

a. Intramedullary epithelioma



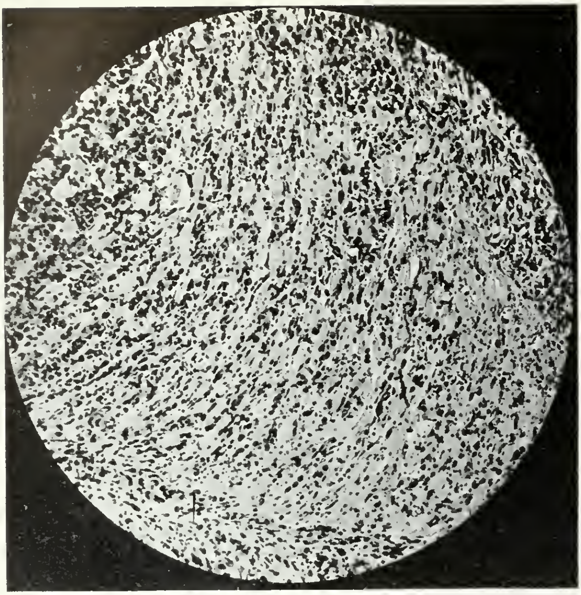
January, 1913. Longitudinal section showing large intramedullary epithelioma. Also bone cyst and sequestrum.

Fig. 9.



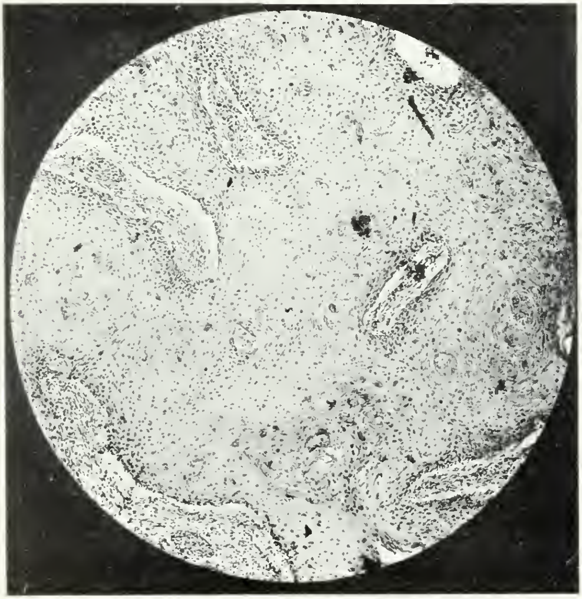
November, 1912. External tumor of thigh, involving skin and muscles (sarcoma and epithelioma).

Fig. 10.



November, 1912. External tumor of thigh, involving skin and muscles (sarcoma and epithelioma).

Fig. 11.



January 2, 1913. Intramedullary tumor (epithelioma).

reports of the microscopical findings by such competent men, are, that the malignant tumor which developed in the pectoral region in April, 1912, which was undoubtedly epithelioma, was a simple example of ordinary X-ray cancer occurring at the site of an old dermatitis of ten years before. The later tumor which developed in the thigh, in the autumn of 1912, started in a similar, but much more severe X-ray dermatitis, following X-ray burns of ten years before. This was of a much more highly malignant nature and grew with very great rapidity. The fact that it started in the skin and never—even at the time of death—reached the periosteum, strengthens the opinion that it was a new and independent tumor resulting from X-ray burns, and having no connection with the original periosteal sarcoma of ten and a half years earlier, which had apparently entirely disappeared. The earlier tumor never involved the skin or muscles, and the later tumor never invaded the bone or periosteum, except the metastatic tumor in the medullary cavity which proved to be an epithelioma. Part of the thigh tumor showed, according to Welch and Ewing, structures which must be classed as sarcoma. Other portions of the tumor showed, according to Clark, typical basal-celled carcinoma, while the intramedullary tumor was clearly epithelioma. It would appear then that we were dealing with different types of malignant disease—sarcoma, carcinoma—in the same individual and approximately at the same locality, resulting directly or indirectly from chronic irritation caused by X-rays. Therefore cysts and sequestra are easily explained as the result of a rather extensive chronic osteomyelitis following the breaking down of the sarcoma of the femur under the influence of the X-rays and toxins and infection from the sinus which persisted after the large exploratory incision. I have known of one other case, reported by one of the German clinics, of an X-ray worker, in which two different types of malignant tumor (one a sarcoma and the other carcinoma) occurred in the neighborhood of the wrist, following a dermatitis produced by exposure to the X-rays. The two types of tumor occurred within two inches of each other. (The reference to this case I am unable to find.)

We are all familiar with the experimental production of sarcoma in the rat, by Marie and Clunet, published in the *Second International Congress for Cancer Research,* Paris, 1910. These investigators set out deliberately to produce a malignant tumor by producing a series of X-ray burns in the same locality, pushing the exposure to the point of ulceration, and when this had healed, repeating the experiment 4 to 5 times. At the end of this time, typical sarcoma developed at the site of the exposures.

The exact method by which X-rays produce a malignant tumor is not known. It would be idle to enter into any prolonged attempt to theorize on this question in the present paper.

I believe that X-ray cancer throws little light upon the great problem of the etiology of malignant tumors in general. It adds little to the evidence for or against the extrinsic or microbic origin of the disease. Personally, I believe it can be better explained by the parasitic theory than by any of the cellular or intrinsic theories. We should simply have to assume the existence of a widely disseminated and very generally present microörganism or virus to which nearly every individual is exposed, and yet, which under normal conditions will be successfully withstood by the resisting powers of the tissues. Under certain unusual or abnormal conditions, such as bruising of the tissues resulting from trauma, or the changes caused by chronic irritations of various sorts, including those occasioned by the X-ray, these tissues lose their normal resisting power and furnish a favorable site or nidus for the microörganisms. When once these have obtained a foothold, it will be found very difficult to control or eradicate them.

Some of those who find it difficult to explain the origin of X-ray cancer on the microbic theory, assume that the infectious agent reaches the site of development by reason of abrasions or cracks or external ulceration. If this were true, it would be hard to explain the development of cancer in cases in which there was no ulceration.

My theory is entirely different, in that I believe the infection reaches the particular locality through the blood supply, just as localized tuberculosis of bones or joints in children develops after a trauma, without any external abrasion. In these cases we must assume a latent organism present in the system, remaining harmless until the trauma so lowers the vitality of the tissues as to furnish a favorable nidus for the organism coming through the blood to gain a foothold.

Hesse, of the University Poliklinik of Bonn (*Zwanglose Abhandlungen aus d. Gebiete d. Med. Elektrologie und Roentgenkunde, Hft.* 10, 1911), has made, I believe, the most careful study of the X-ray cancer up to the present time.

Of 90 positively determined malignant tumors following the exposure to X-rays, occurring in 54 patients, 5 or 5.5 per cent. were tumors resembling fibrosarcoma. Only one was a spindle-celled sarcoma as proven by histological examination. Hence, there was but one positive Röntgen sarcoma in the entire series.

Of 94 Röntgen lesions reported, 54 were cases of uncomplicated carcinoma, including one case of sarcoma, the latter in conjunction with "cancroids"; in 13 cases the diagnosis was not absolutely certain or there were other complications; and 27 carcinomas in cases of X-rayed lupus. Twenty-six of the positive cases were observed in America, 13 in Germany, 13 in England and 2 in France.

Hesse brings out the important point that Röntgen carcinoma never develops as a simple or primary injury due to raying, but exclusively in the soil of an already present Röntgen injury.

As regards the etiology of Röntgen carcinoma, he believes that one should certainly consider the possibility of their being due to some kind of infection, either bacterial or protozoic. He states that the skin, which has been exposed to the X-rays, is full of cracks and ulcers, often as thin as tissue paper, and with little or no power of resistance, offers a favorable soil for the entrance of foreign organisms.

Against the infectious theory, he mentions the fact that in some patients the carcinoma develops in cicatrices that had not shown any sign of inflammation for a long period, in which cases one would have to assume that the cancer germs had remained latent in the tissue and then had become active for some unknown reason. Nevertheless, he states, the infectious theory cannot be excluded.

With reference to therapy, he believes that limited success may be obtained by symptomatic treatment. He adds " The Röntgen carcinoma itself cannot be treated radically enough, and the soil of the carcinoma cannot be treated mildly enough."

Referring to the prognosis, he states that without treatment the carcinoma invariably causes the death of the individual afflicted. Under treatment the cancer as such may be cured but a *restitutio ad integrum* is impossible. A complete cure of the xeroderma pigmentosum does not occur, although attempts to bring the same to a stage where it will cease to further generate carcinoma, may be successful.

A NOTE ON CANCER OF THE THYROID, AND ITS EXTENSION TO THE LUNGS BY MEANS OF THE BLOOD-VESSELS.

BY FRANCIS J. SHEPHERD, M.D., F.R.C.S.E. (Hon.),
OF MONTREAL, CANADA.

CASES of cancer of the thyroid are always undesirable to operate on. The writer has operated on many but in very few has the result been entirely satisfactory. The majority of cases have succumbed to local extension at the site of the disease; others have had no local recurrences but have died from extension to the lungs. In only one has a satisfactory result been obtained, this was operated on some ten years ago. After a second operation for recurrence the patient became myxœdematous and has been obliged to take desiccated thyroid ever since but is in good health.

In some cases the extension to the lungs is through the lymphatics, but again the transmission may be directly through the blood-vessels, as in the case reported below. This method of extension is much more common than is supposed and accounts for the rapid dissemination and termination of such cases. In the case under consideration, however, it was some years before the disease extended and for four years she continued her vocation in perfectly good health. When, however, the tumor again showed itself in the neck the growth was rapid and extension to the lungs by means of the blood-vessels quickly followed. This was strange as no glands in the neck or its neighborhood were involved, which accounts, no doubt, for the long interval of comparative health.

This case also teaches us that patients suffering from early cancer should always be operated on, for relief for a time is generally obtained. One case operated on some fifteen years ago had been under observation for a year or more, the patient steadily refusing operation. However, the growth suddenly enlarged greatly (evidently due to hemorrhage), causing great discomfort. Immediate operation showed that the sudden enlargement was due to hemorrhages into a number of cysts in the gland. Convalescence was uninterrupted, but eighteen months later the patient began to spit blood and consolidation of the left lung was found. He died two months later of exhaustion due to extension of disease to the lungs and frequent hemorrhages. In this case there was no local recurrence and the extension of the disease was through the blood-vessels, the glands not being involved.

Case Report.—Mrs. D., aged thirty-nine, consulted the writer on January 13, 1907, for an enlargement of the thyroid, stating that the neck had been enlarged since childhood and only during the last four years had it grown to its present size. The tumor, which was solid, occupied the whole thyroid, the enlargement was as much on the right as on the left side and quite smooth. She wished to have the growth removed because she was breathless on exertion and had violent attacks of palpitation. Quite recently her voice had changed. She had a pulse of 120 but no other sign of Graves's disease, except great excitability, no exophthalmos, no tremors and no œdema of the extremities. Of late she had lost much weight. Operation, January 17, disclosed a tumor occupying chiefly the left lobe. The whole tumor was removed with great ease and she went home much relieved with the wound soundly healed in two weeks. The pathological report was carcinoma.

In August of the same year (1907) she reported herself quite well and said she could do more work than she had done for years. On January 4, 1911, she reported that the tumor had commenced to grow again on the left side and was of considerable size, though she felt little discomfort. On July 4, 1912, five years after the first operation, she again presented herself, at which time she was in great distress, breathing with difficulty and speaking only in a whisper. She had a tumor the size of an orange in the region of the thyroid, which was quite immovable. She begged for some operative relief so on January 6 an attempt was made to remove the growth. The patient was much emaciated and weak and had not been able to attend to her business for some months.

She took ether badly and there seemed to be obstruction low down, so a laryngeal tube was inserted. This gave no relief and ether was discontinued and the skin was infiltrated with novocaine. The large mass on the left side was dissected out. The trachea was found flattened and pushed to the opposite side but the larynx itself was free from infiltration. The patient's condition was now so bad that it was decided to do nothing further; the right side was left alone as it was not pressing on the trachea and she was breathing quietly. The wound was closed and the patient removed to the ward. She died some twelve hours later.

The postmortem, which was performed by Dr. Rhea, pathologist to the Montreal General Hospital, showed the following interesting findings:

"The thyroid gland cannot be found as such; corresponding to the site of the right lobe is a large, firm, calcified mass, 6 x 4 cm. with a mass of soft tissue at the lower extremity. The trachea at this point has been displaced to the right and shows flattening on the left side. Occupying the site of the left lobe is a cavity from which a mass of tissue has been apparently removed. The tissues around the trachea are infiltrated with new growth and the phrenic and recurrent laryngeal nerves are bound down and involved by tumor tissue. The left innominate vein is enormously distended and on palpation contains a firm, irregular mass, which on opening is found to be a new growth springing from the posterior wall of the inner surface of the vein and almost occluding it.

"*Lungs.*—In the superficial portions of both lungs several firm, round nodules are felt. Upon section these are found to be small metastatic tumors. They are found mostly in the lower lobes. No thrombi could be demonstrated in the veins or arteries.

"*Microscopical Description.*—The tumor tissue is of the same character wherever found. The tissue consists of cords, groups of cells and acini, separated by a connective tissue stroma. The relative proportion of these elements varies somewhat in sections from different locations. The essential cell of the tumor is epithelial. These cells vary in size and shape, depending on the pressure to which they are subjected. The acini are small and most of them are empty, but some contain colloid material.

"Sections through the wall of the innominate vein and tumor attached to the inner surface show the following: The wall of the vein is thickened and attached to its inner surface is a mass of tissue consisting of tumor cells and stroma; mediastinum and peribronchial tissues show no tumor cells."

HYGROMA CYSTICUM COLLI

ITS STRUCTURE AND ETIOLOGY.

BY CHARLES N. DOWD, M.D.,

OF NEW YORK.

Professor of Clinical Surgery in Columbia University.

SCATTERED through the books on surgery and pathology one may find pictures of children with enormous swellings of the neck which are described as hygromas. Although there are a few definite descriptions the statements about these growths are often indefinite, sometimes contradictory, and give evidence of having been copied from one author by another without the opportunity of extensive personal observation. At least three types of growth have been included in some of the descriptions.

1. Cystic tumors which have endothelial linings and serous contents and which grow with much power through the tissues of the neck or downward under the clavicle into the axilla or pectoral region.
2. Lymphangiomas.
3. Branchial cysts.

The term hydroma should be confined to the former class. They are usually described as cysts of lymphatic origin. The loculi are sometimes described as dilated lymph spaces.

The dividing line between them and lymphangiomas may not always be absolutely definite but the typical examples of each are distinct.

Since branchial cysts are now well understood one hardly sees how they need be confounded with hygromas.

The etiology of hygromas is usually referred to as unknown, although several theories for their origin have been given.

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* Read before the American Surgical Association, May 8, 1913.

These growths are rare, the total number described in surgical literature is small. Conversation with friends who would have been likely to see them indicates that they are very uncommon.

Rare cases however come in groups, and after having done neck surgery for many years without seeing a single case the writer has within the last year operated on three undoubted cases and a fourth which was probably such a case but in which inflammation had obliterated the finer structure of the cyst wall.

Most of the peculiarities which have been described in the reported cases have been present in one or more of those cases and their histories are here given in detail. The first one, a child of two and three-quarter years, gave the following history.

Case I.—J. K., age two and three-quarter years. Admitted August 22, 1912. Died Sept. 30, 1912. Nationality, U. S. (Russian). Roosevelt Hospital, History No. B3034.

Chief Complaint.—Swelling of right neck and shoulder.

Present Illness.—When patient was three months old the mother first noticed a small swelling, the size of the tip of the little finger, just above the middle of the clavicle on the right side of the neck. The skin over it was normal, it was not painful or tender and could be made to disappear by firm pressure downward. The lump has been gradually growing larger in spite of firm bandages, which used to make it disappear but no longer do so. Following whooping-cough last winter it grew rapidly larger. Four days before admission patient had a fall, striking the lump, since which time it has been somewhat reddened and slightly tender. Otherwise a healthy normal child. Bowels regular, appetite rather poor.

Past History.—Has had whooping-cough, pneumonia twice, had "yellow jaundice" one year ago. Is rather subject to coughs. Had a similar lump egg-sized in right axilla, with some symptoms of reducibility, removed at a dispensary last year.

Family History.—No history of tumors or fistulæ about the neck. No "lung trouble" in family.

Physical Examination.—Patient is a well-nourished, healthy looking girl baby, appears restless but not ill.

Local Condition: On the right side of the neck is a globular swelling about 4 inches in diameter extending from the acromion to the anterior border of the sternomastoid and from the spine of the scapula to well in front of the clavicle. The skin over it is smooth but somewhat ecchymotic as from a contusion. On palpation it is soft, fluctuating and can be somewhat reduced in size by firm pressure. It is apparently not tender. On forced expiration there is an expansile impulse, percussion flat.

Eyes, Ears, Nose, and Throat: Negative.

Skin: Reddish maculopapular eruptions on chest and back.

Chest: There is marked inspiratory retraction of lower ribs in front on both sides, sternum very prominent.

Lungs: Clear.

Heart: Not enlarged. Sounds of good quality. There is a rough systolic murmur heard over the left half of base, transmitted upward toward both clavicles.

Abdomen: Rather a pot-belly with an umbilical hernia. Liver and spleen not felt.

Extremities and Genitals: Apparently normal.

Operation (August 23, 1912).—A transverse incision was made above the clavicle and parallel to it. The cyst was enucleated through this incision as far as the pedicle which came just in front of insertion of sternocleidomastoid muscle at the inner edge of sternum. When the cyst was opened it was found that it ran in under the sternum into the thoracic cavity but extrapleurally. It was shaped like an hour-glass and the constricted portion was large enough to admit the finger, the inner dilated portion seemed to have a content of 3–4 oz. and went up as far as thyroid and downward under the sternum for about 2 inches, outward under the clavicle for an inch or more. As much of this lining membrane as could be dissected away was drawn out into the wound and cut off. No attempt was made to lay open this entire inner dilated portion, the condition of child would not warrant so extensive a procedure. Wound closed without drainage. Time of operation 45 minutes.

The recovery from the operation itself was prompt and satisfactory, but the swelling quickly recurred and on September 17, a second operation was done.

Second Operation (September 17, 1912).—Anæsthetic, ether. A transverse incision was made from inner end of clavicle well back to posterior portion of neck. The skin and superficial fascia were dissected up and the cyst found to have reformed in the position where it previously existed. The prolongation which extended down under the sternum could not be found. The cyst was 3 x 4 inches long and 2 inches wide. It presented the same characteristics as the one previously removed. It was dissected out in its anterior and lower and upper portions and was found to have a pedicle which extended inward and backward and posterior to one of the scaleni muscles. After careful dissection this pedicle was divided but it frayed out and there was no evidence of an opening which extended further. The cyst contained clear serous fluid; there was considerable fatty tissue on its outer side, also some lymphatic tissue. The wall was thin and similar to one previously removed. There was no evidence of epithelium or communication with the deeper structures.

The child showed considerable reaction after the second operation. There was free serous discharge, on the seventh day there was hemorrhage from the wound, some oozing on the following day and on the tenth day she died.

Pathologist's Report (R. H. Pat. No. B-506).—J. K., August 23, 1912.

Specimen: Cyst wall.

Gross Examination: Specimen consists of a thin-walled smooth cyst, with an opening about 2 cm. in diameter at one end. Some areas are red in color, others thin and upon holding to light are translucent. A small thin-walled cyst containing a few drops of serous fluid was found within the cyst wall.

Microscopic Examination: Section shows a thick-walled cyst which is involved in a chronic inflammatory reaction. There is an increase in fibrous connective tissue especially around the blood-vessels which are numerous. Areolar tissue is present in the outer portions in which there are scattered aggregations of lymphoid follicles. No definite type of cell can be made out lining the cyst though in some places they have the appearance of much flattened endothelial cells. This innner part of the wall shows a marked infiltration of round cells.

Diagnosis: Chronic inflammation of cyst wall.

Pathologist, Baldwin Mann, M.D.

Pathologist's Report, second specimen. (R. H. No. B-786).—J. K., age two and three quarter years, Sept. 17, 1912.

Specimen: Cyst.

Gross Examination: Specimen consists of a mass of fibrous and fatty tissue containing a few lymph nodes, and a small smooth lining of a cyst.

Microscopic Examination: Section is composed of muscle and connective tissue, containing numerous rather congested blood-vessels, considerable fat and a few nerves. Round cell infiltration is present throughout. There is a definite cyst lined by a single or double layer of rather large cells with elongated nuclei. Lymph node shows moderate hyperplasia.

Diagnosis: Cyst wall showing chronic inflammation. Moderate hyperplasia of lymph node.

Pathologist, Mortimer Warren, M.D.

Case II.—J. A., age twenty months. St. Mary's Free Hospital for Children. History No. S. 10979. January 18, 1913. Sent by Dr. John McBarron. Ever since birth the mother had noticed what she called a "bubble" just beneath the left clavicle. This apparently diminished on pressure and the mother had not noticed any apparent change in it until two weeks or so ago. Then decided enlargement appeared over the upper left side of the chest in front. The child was sent to the hospital and found to have a very prominent cystic tumor in this locality. Just beneath the clavicle the cyst seemed thin walled, further down it had apparently thicker walls. It extended from the sternum to the outer edge of the pectoralis major and from the sixth rib to the clavicle.

The child's parents were first cousins and the entire family of six children had been defective in some way. This one seems idiotic. It was impossible to keep him quiet long enough to get a good picture of him and finally the picture had to be taken while he was under an anæsthetic.

Operation (January 21).—A curved incision with its convexity outward was made from above the clavicle to the sixth rib and axillary line. The pectoralis major was found to be in front of the cyst. Its fibres were therefore split with the hope of extracting the cyst through this split; this however was not possible. It was found that a portion of the cyst projected between the upper fibres of the pectoralis major and the clavicle. Finally the entire width of the pectoralis major was divided. The cyst was then found to press forward from beneath the clavicle. The axillary vessels and the brachial plexus were pushed forward. The cyst had extended beneath the pectoralis minor, and also in front of it so that it enveloped it. It was multilocular, the locules having walls of different thicknesses and varying in size from a pullet's egg down. In some places the walls were very thin indeed so that these cysts ruptured on pressure. It was found that this growth extended well upward into the neck, portions of it being found beneath the lower portion of the sternomastoid muscle. The general appearance of the growth at the time of operation is indicated in Fig. 7, which was constructed from a sketch made by Dr. E. H. Pool at the time of operation. The cysts which broke contained thin serous fluid slightly yellowish in tinge. The growth extended over so far to the left as to involve the capsule of the shoulder-joint, and in the course of the dissection this joint was opened. It was manifest that it had the power of independent growth. The manner in which the clavicle was pushed forward, the axillary vessels and the brachial plexus were separated from it, the pectoralis major was pushed forward under strong tension, the pectoralis minor was enveloped both in front and behind, all gave evidence of a mass which was pushing its way along these tissues and following the line of least resistance.

This child made a reasonably good recovery from the operation and went home in a month.

At a later time in the winter he developed a sore throat with laryngeal obstruction and died.

Dr. Wm. C. Clarke, the pathologist of the hospital, was present at the operation and stained a part of the cyst wall with protargol as soon as it was removed, thus hoping to determine the character of the lining cells. A very beautiful endothelial lining was thus shown (Fig. 8). His report is here given.

Pathological Report.—J. A., 2293. February 5, 1913.

Gross Examination: Specimen consists of a sharply outlined lobulated oval tumor mass measuring 6 x 8 cm. Attached to this mass are two collapsed sacs of tissue; their walls are at points thin, elsewhere reinforced by considerable adventitious tissue.

Extending inward from the walls of the cavities are folds or reduplications that form compartments. These compartments or recesses connect with the main cavities of the sacs and are also crossed by numerous trabeculæ. There are other smaller cysts in these partitions. The content of these smaller unopened cysts is straw colored fluid.

The lining membrane of all the cavities is smooth and glistening. The substance of the sac wall is soft and resilient. This tissue is red, does not contain exudate, and there are no inflammatory signs present.

The uncollapsed mass on cut section is also found to be a cyst. The walls are 0.4 cm. in thickness. The tissue forming the wall is light in color and contains a small amount of inflammatory exudate. The cyst itself contains coagulated, clear, jelly-like exudate with radiating striations in the mass. This coagulated exudate is firmly adherent to the lining of the cyst cavity. Because of this, the lining of the wall is roughened and shaggy in appearance, not smooth and glistening as in the other cysts of the specimen. This portion of the specimen suggests that the cyst wall had been recently inflamed. Since the exudate as it poured out contained fibrinogen, fibrin was thrown down and the jelly-like coagulum resulted.

Microscopic Examination: Flat sections were stripped from the lining of the cyst cavities and were inpregnated with protargol. Following precipitation of the silver salt in the sunshine, it was found that all but the cyst that contained coagulated exudate was lined by completely specialized endothelium.

The salt was precipitated in such a manner that a mosaic, was formed of black lines of silver. This mosaic defined the margins of the lining cells, showing that they covered the surface in an even and distinct layer characteristic of the lining endothelium of established blood or lymph channels, and not characteristic of connective tissue lined cavities, as in a joint or bursa for example.

Sections from wall of uncollapsed cyst show a definite connective tissue stroma resting on striated muscle bundles. The lining of the cyst is covered by dense masses of fibrin in the meshes of which are many leucocytes and well preserved red blood cells. The actual lining cells of the cyst are elongated fibroblasts which infiltrate the attached fibrin. Where the fibrin is deficient the lining cells are flattened and evenly disposed with no tendency to project outward into the cyst cavity.

Sections from the walls of the sacs which had contained clear fluid show that the cells are flattened out and present a distinct cell wall corresponding to the tangential sections of the silver preparations. At points in the cyst walls are many cavities containing dense masses of red blood cells and apparently no fibrin. The outline of these cavities is sharp and distinct with no tendency on the part of the lining cells to grow in among the red blood cells.

Pathologist, William C. Clarke, M.D.

Case III.—W. F., aged eleven months. St. Mary's Free Hospital for Children, History No. S. 10949. Jan. 18, 1913. Patient sent by Dr. Leonard Adair. At birth a slight protrusion was noticed on right side of neck. It has been gradually increasing, especially since a cold appeared ten days ago. Now there is a large cystic swelling on the right side of neck extending from clavicle, acromion and border of scapula up two-thirds of the way to ear, looks as though it contains 6 oz. of fluid. Child looks fairly well nourished. The child went to the hospital with a temperature of 103°, this temperature subsided, but at the time of operation he had a temperature of 101°

Operation (January 21).—A long transverse incision was made and the fatty subcutaneous tissue was found to be œdematous. The cyst wall was not as definitely limited as if this œdema had not existed but it was fairly well dissected out. It extended forward to the sternomastoid muscle above the clavicle and behind its border. It extended backward under the trapezius and was so intimately adherent to the scaleni muscles that they were separated from it with great difficulty. Some of the branches of the cervical plexus were adherent in the wall of the growth. The posterior branch of the eleventh nerve could not be found.

An opening was made into the cyst wall fairly early in the operation and several ounces of pus exuded, this was reasonably thick, greenish in color and contained no coagulæ. When the mass was removed a smooth friable lining was found in its cavity. There were no lymph nodes apparent. The wound was partially closed, and drained. It healed satisfactorily and the child left the hospital two weeks after the operation.

Bacteriological examination of the pus showed both pneumococci and streptococci.

The microscopical examination of the cyst wall is given below.

Pathological Report.—W. F., 2292. February 5, 1913.

Gross Examination: Specimen consists of a sac wall the outer structures of which are fat and recent tissue. At one point the wall is distinct and free from fat.

The sac wall over the larger part of the specimen is 1 cm. in thickness diminishing from this extreme measurement to 2 mm.

The inner surface is exceedingly smooth and presents several folds and trabeculæ which partially subdivide the cavity. This inner lining is also exceedingly friable.

Cut section of the more solid portions of the wall show that there are two minute white areas in the lining of the main cavity. The tissue itself is yellowish pink with areas of fat.

There are no areas of definite degeneration. Sections of wall removed in fresh state and impregnated with protargol. After precipitation of the silver salt by sunshine, microscopic examination of lining showed that there were indifferent markings of silver but no distinct cell outline.

Hæmatoxylin and eosin stain of cross section of cyst wall shows that it consists of granulation tissue. This granulation tissue is infiltrated with countless leucocytes and fibrin strands.

There are no areas of degeneration, no giant-cells and no epithelioid cells.

Microscopic examination of lymph node adjacent to cyst wall shows simple hyperplasia.

Diagnosis: Cyst of neck acute inflammation.

Pathologist, William C. Clarke, M.D.

Case IV.—J. F., aged two years. St. Mary's Free Hospital for Children, History No. S. 11450. April 1, 1913. At birth there had been a slight "bubble like" swelling in the left side of the child's neck. This had increased during the last few months and had been treated by several doctors. One of them had drawn off considerable clear fluid by aspiration but the cyst had quickly filled again.

Physical Examination.—There was a cystic tumor on the left side of the neck which extended from behind the sternomastoid muscle forward almost to the median line and from the mastoid process nearly to the clavicle. This was very near the skin in some places and was apparently very thin walled. It fluctuated on pressure; there was no inflammation and the skin was not discolored over it.

Operation (April 1, 1913).—Transverse incision which had to be carried across the sternomastoid muscle. This muscle was divided. The cyst was multilocular, very thin walled, dark looking in places and extended up into the interstices of that portion of the neck. In removing it the internal carotid and internal jugular veins had to be separated for two inches or more. The internal jugular vein was liberated from it with great difficulty as it was densely adherent to it. The pneumogastric, phrenic and spinal accessory nerves were exposed for long distances. The cyst walls were attached firmly to the deep aponeurotic structures of the neck and the dissection went well down to the transverse processes of the cervical vertebræ, exposing the branches of the cervical plexus as well as the nerves previously mentioned. Apparently it was completely removed, but certain portions of the hygroma were so thin walled and the loculæ so small that their delicate structure could not always be distinguished from the normal tissues and it is possible that some little portions remained behind.

Wound was closed and child made a good recovery.

Pathological Report.—J. F., age two years. Specimen No. 2444. St. M., No. 1371. April 2, 1913.

Gross Examination: Specimen consists of a sharply outlined lobulated tumor mass somewhat oval in shape and measuring about 5.5 + 4 cm. Extending from the surface of this mass are a number of small thin and transparent walled cysts which in one area are joined together forming a chain. These small cysts are bound together as well as to the main tumor mass by strong bands of adventitious tissue. Attached to the tumor are two greatly enlarged lymph nodes.

The main cavity of cyst is divided by means of folds into a series of smaller cavities or compartments. Traversing these compartments are a number of fine strands or trabeculæ. The cysts contained a thin serous straw colored fluid.

The main cyst is lined by a smooth, glistening, pearly membrane. The sac wall is soft, elastic and very dense.

On sectioning one of the uncollapsed and smaller cysts the wall, though very thin, is found to be extremely dense and containing under considerable pressure a thin serous fluid.

The lining membrane of these cysts is similar to that of the larger one, namely, consisting of a pearly white membrane very smooth and glistening. There is no inflammatory reaction around the tumor. Specimen dissected from lining wall of cyst was impregnated with protargol.

Microscopic Examination: Tangential sections show the silver salts deposited in the intercellar cement substance giving to the tissue a mosaic appearance. The cells are seen to be highly specialized endothelial, similar to that seen lining the inner surface of blood and lymph vessels. The cyst wall is composed of a very definite connective tissue stroma, with no signs of inflammation.

Diagnosis: Hygroma.

Pathologist, Wm. C. Clarke, M.D.

One who studies these cysts must be impressed by two facts:

1. Their endothelial structure and multilocular development differentiate them from any of the other growths which are found in this locality.

2. They had an independent power of growth which was sufficient to force them with great power into the surrounding tissues.

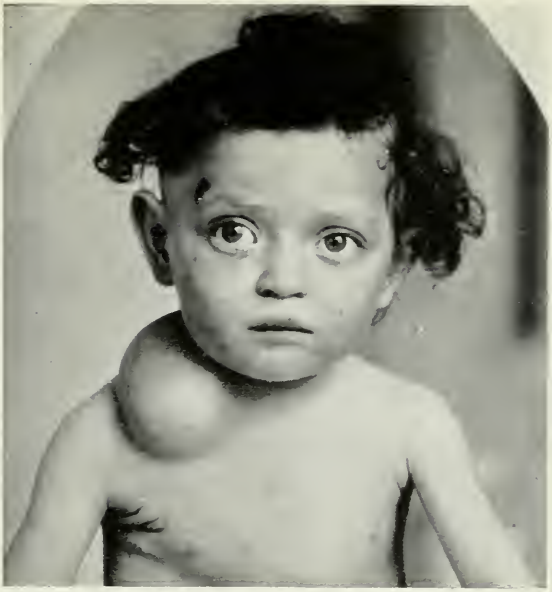
The beautiful endothelial cells which existed in the second and fourth cases are shown in Figs. 8, 14 and 15, and a cross section of the endothelial structure which existed in the first case is shown in Fig. 3. Although a cross section does not show all the details of endothelium the cyst lining shown in

Fig. 3 very closely resembles that shown in Fig. 9. These linings differ from the epithelial linings which are found in branchial cysts and do not correspond to the tumors which are found in connection with ordinary lymph nodes. The structure is much more definite than one would find in an ordinary malignant tumor. The endothelial structure resembles that which is found in lymphatic vessels or in certain blood-vessels. It does not look like that which is found in joints or bursæ or which is developed in ordinary connective tissue.

We may dwell a little more at length on the enormous growing power which these cysts showed. The first one had worked its way forward above the clavicle and pushing around the internal border of the sternomastoid muscle had pushed downward behind the clavicle and behind the sternum, forming a saddle bag shaped cyst. When the child coughed and forced the fluid from the internal into the external part of this cyst the effect was startling. The external part of this cyst is indicated in Figs. 1 and 2. The communication between the two parts was large enough to easily admit the finger and the internal part extended for a wide distance behind the sternum into the mediastinum. The pressure force which carried it there must have been very great. When the external part of the cyst was removed and the pressure thus relieved, its internal part collapsed and healed and was not to be found at the second operation.

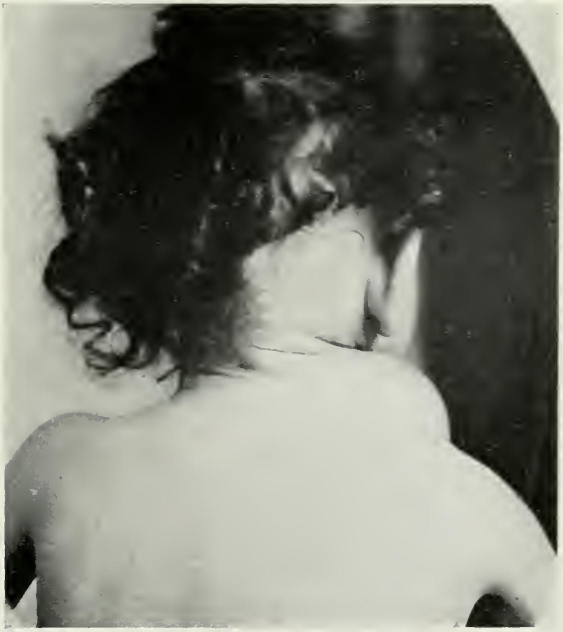
The growing power was shown again by the rapid recurrence between the two operations. Apparently all but the mediastinal part of the growth had been removed at the first operation, yet at the second operation, twenty-five days later, there was a multilocular thin walled cyst almost as large as the first one. The growth was as rapid as that of a very malignant tumor. The growth of the cyst in the second case had progressed with similar force. The way in which it pressed down into the axilla and enveloped the pectoralis minor muscle was remarkable. The first one formed a saddle bag cyst around the sternomastoid muscle, the second one formed a similar saddle bag cyst around the pectoralis minor muscle and pushed the pectoralis major forward so as to make

Fig. 1.



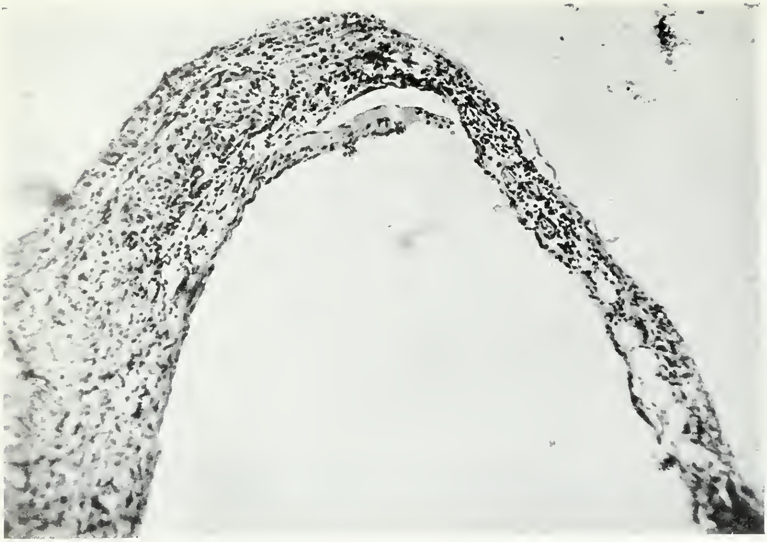
Cystic hygroma of neck. This cyst was multilocular. One portion extended around the lower inner border of the sternomastoid muscle into the mediastinum and formed a saddle-bag shaped cyst. Expansion could be noticed in the outer part when the child coughed. It contained clear fluid and was apparently lined with endothelium.

Fig. 2.



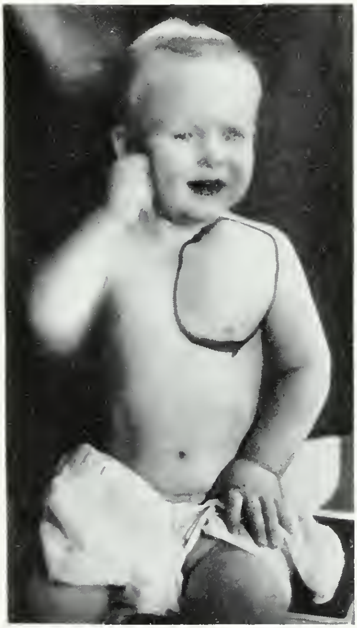
Posterior view of cyst shown in Fig. 1.

Fig. 3.



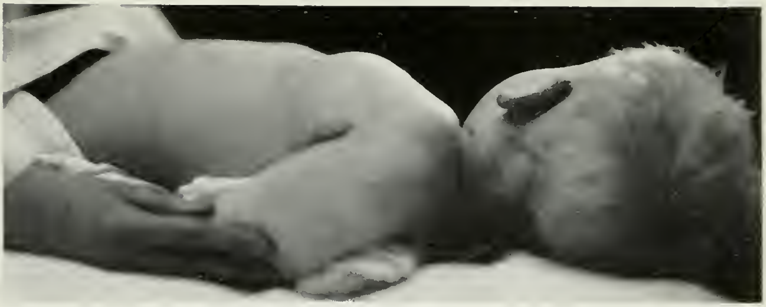
Cross section of cyst wall, Case I, showing lining which is believed to be endothelium a fibrous cyst wall, and round-celled infiltration.

Fig. 4.



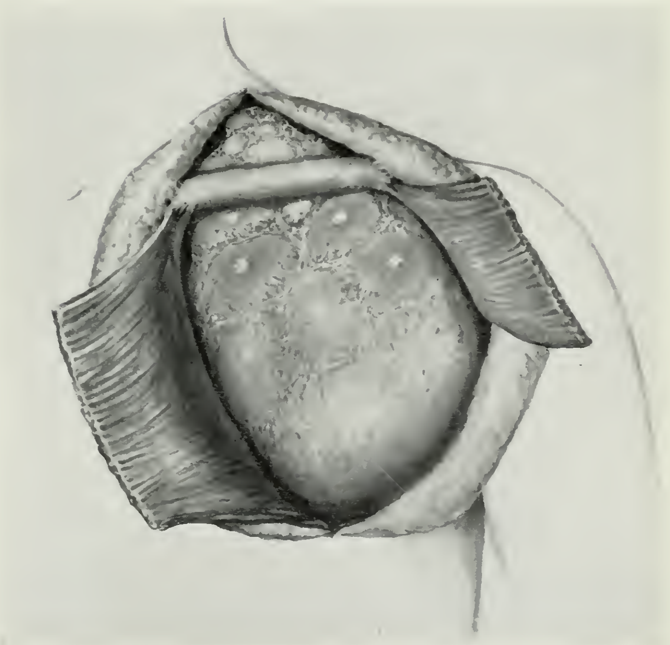
Case II. Cystic hygroma of neck and chest. The iodine mark indicates the boundaries of the cyst.

Fig. 5.



Case II. Cystic hygroma of neck and chest, side view. The growth extended under the pectoralis major muscle and pushed it forward.

Fig. 6.



Case II. Diagram of cyst from drawing made at time of operation (by Dr. Eugene H. Pool). The pectoralis major muscle has been divided and laid back from each side so as to expose the cyst *in situ*. The thoracic portion of the cyst seemed more recent than the cervical portion.

FIG 7.

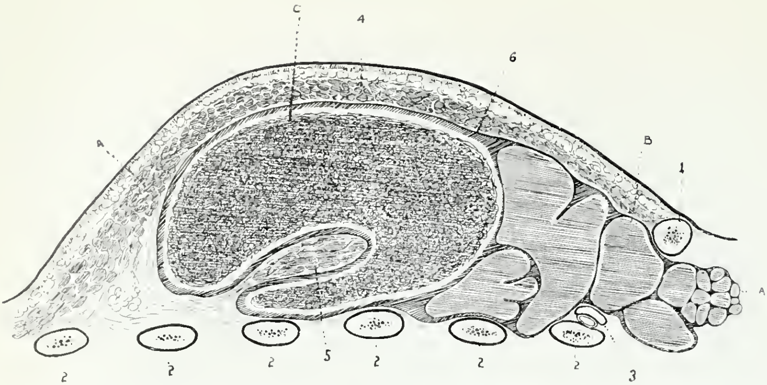
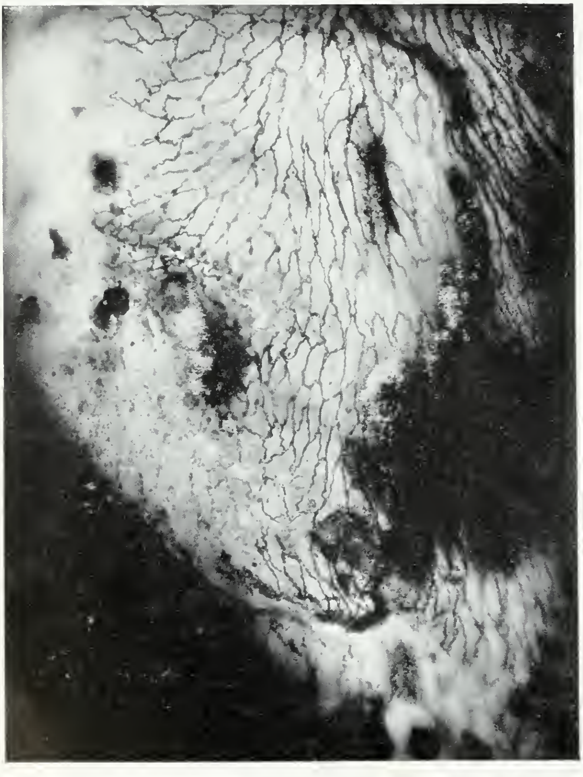


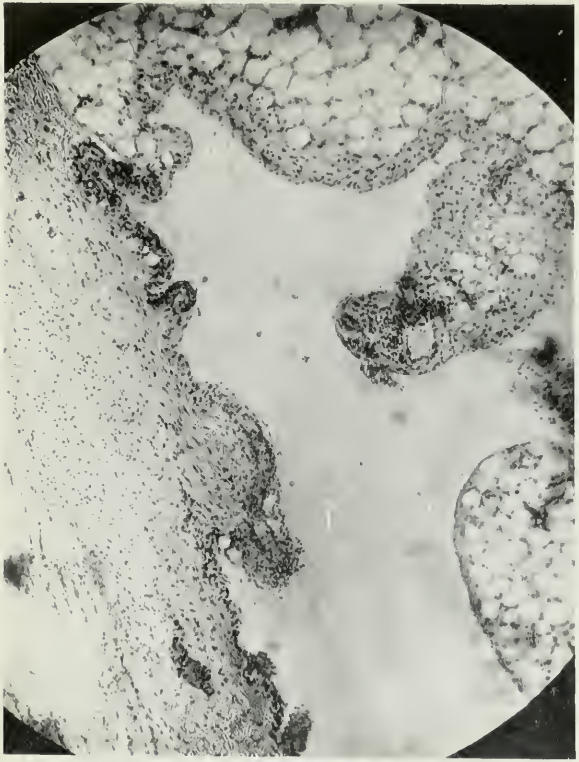
Diagram of vertical section of anterior chest wall and hygroma. (From drawing made by Dr. Wm. E. Clarke.) 1, Clavicle; 2, ribs; 3, axillary vessels; 4, pectoralis major muscle; 5, pectoralis minor muscle; 6, wall of cystic hygroma; *A*, small cysts in neck; *B*, larger cysts between clavicle and chest wall; *C*, cyst which had pushed in front and behind pectoralis minor muscle in saddle-bag shape. There were cocci and small round-cell infiltration in the wall of this portion of the cyst and there was fibrin in its content. Inflammation was thus indicated.

FIG. 8.



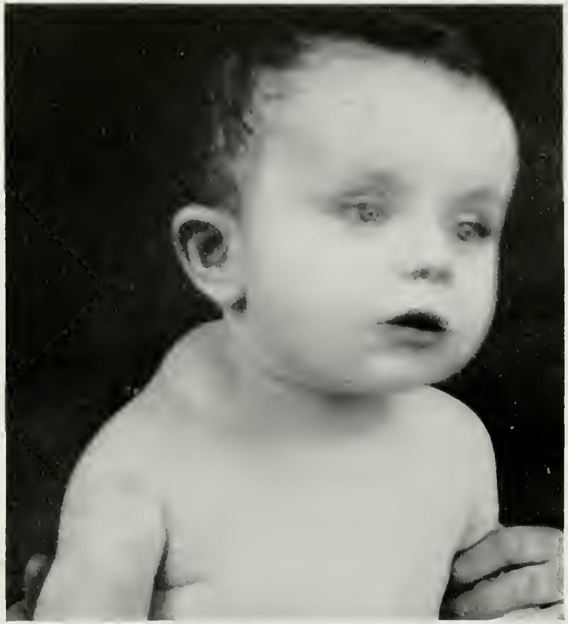
Case II. Cyst lining stained with protargol, showing delicate outlining of endothelial cells.

Fig. 9.



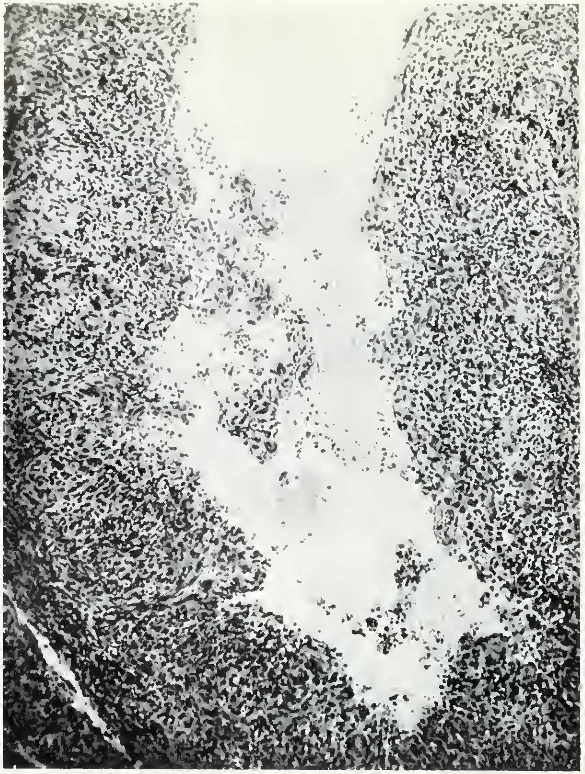
Case II. Cross section of cyst wall, showing endothelial lining, fibrous structure of wall and slight round-celled infiltration. This section is very similar to Fig. 3.

Fig. 10.



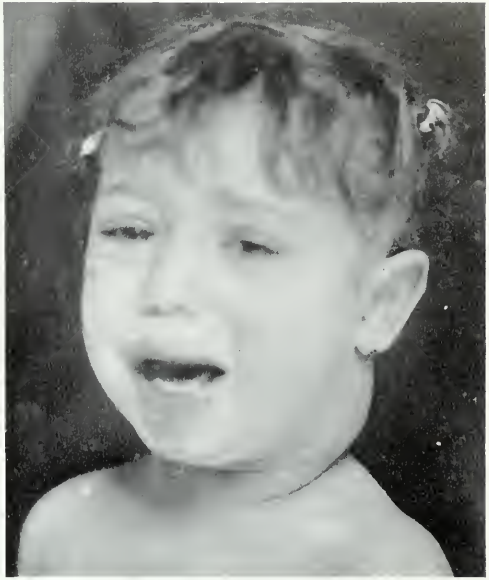
Case III. Believed to be hygroma of neck in which inflammatory changes had occurred. The history of the patient and the appearance of the cyst indicated "hygroma," but inflammation had so changed the cyst walls and contents that the original structure could not be definitely determined.

Fig. 11.



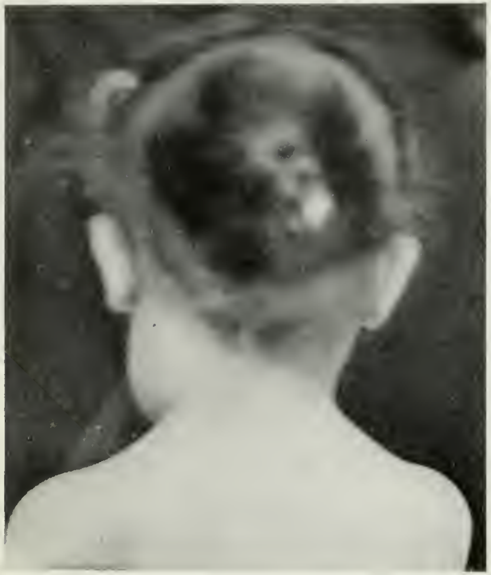
Case III. Cyst wall, showing extensive inflammation and small round-celled infiltration and disintegration of the cyst lining.

Fig. 12.



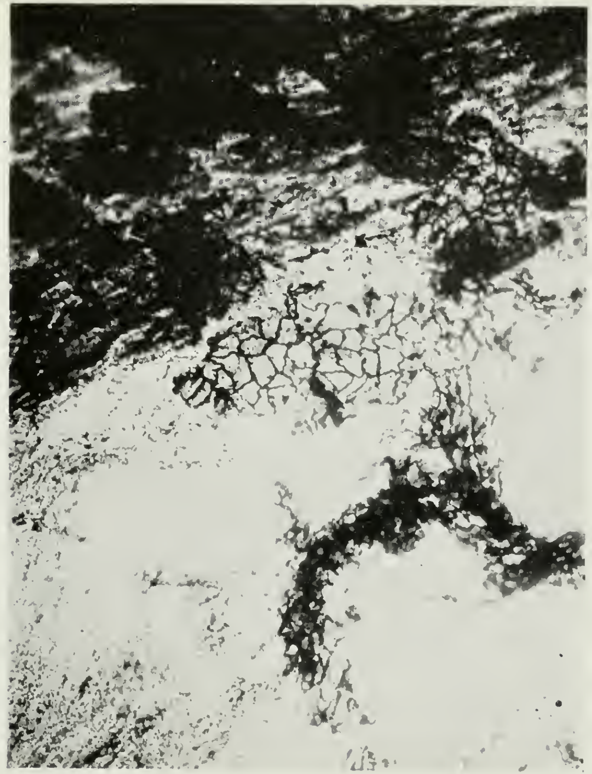
Case IV. Cystic hygroma of neck, child aged two years. A small cyst was present at birth and had recently increased in size. Clear fluid had recently been aspirated but the growth had continued. The endothelial lining of this cyst is shown in Figs. 14 and 15.

Fig. 13.



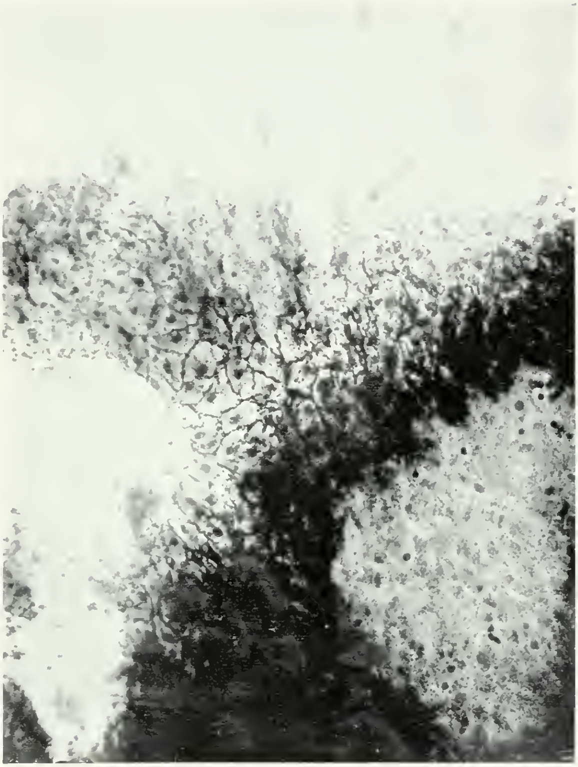
Case IV. Rear view.

Fig. 14.



Microphotograph of portion of cyst wall from Case IV. The outlines of the endothelial cells are marked by protargol stain.

Fig. 15.



Portion of cyst wall from Case IV. The outlines of the endothelial cells are stained by protargol, their nuclei are stained by hæmatoxylin.

a great protrusion on the anterior chest wall (See Figs. 4, 5 and 6).

The peculiarities of the cyst growth were well shown in the second case. The translucent loculi, which apparently were the most recently formed, contained clear serum and had very thin walls with delicate endothelial lining; on the other hand, there was at least one other loculus which showed in its wall inflammatory infiltration of small round cells and the presence of cocci; its contents were coagulated and jelly-like.

The wall of the cyst in the first case also showed inflammatory thickening.

The presence of inflammation in the walls of these two cysts suggests an explanation for the more extensive inflammation in the wall of the cyst in the third case.

All of these cysts corresponded to the ordinary method of development which has been described, in that there was a small bubble-like growth at birth which was almost quiescent for many months and which then took on rapid growth.

Etiology.—One's curiosity must be excited by the presence of these cysts. In order to explain them one must account for cystic lymphatic tissue which was present at birth, which was nearly quiescent for a long period and which then took on rapid forceful growth.

Max Borst,[1] has given a résumé of our knowledge on the subject. He states that their cause is not entirely clear. Luschka and Boucher consider them as arising from the intercarotid ganglion. Arnold opposed this and thought it a cystic development of the connective tissue. Others thought they were connected with the thyroid. Gurlt and Rohitansky, a subcutaneous hydrops. Lucke, Koster, Klelos, an endothelial cyst arising from lymph vessels.

He suggests the presence of a congenital sequestration as the cause.

Arnold[2] who studied the subject most thoroughly as far back as 1865 thought that a congenital defect underlay the condition.

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[1] Die Lehre von den Geschwülsten, Weisbaden, 1902, p. 204.

[2] Virchow's Archiv, 1865.

It is to this theory of an embryonic sequestration that I will particularly ask attention. A sequestration of lymphatic tissue which had in it an independent power of irregular growth offers a satisfactory explanation for all the conditions found.

It is unnecessary before this audience to review the entire question of embryonal sequestrations or rests. All here know that in the growth of the body fragments may be separated from the main portion of any one of the organs and that the closure of embryonic ducts or the development of other embryonic structures may be incomplete. The sequestrations or rests thus remaining may under certain conditions develop in irregular ways. Thyroglossal, branchial, dermoid, ovarian, parovarian, mesenteric or urachal cysts may be examples of such growth. Sometimes the growth seems little more than the distention of closed ducts owing to the activity of the epithelial cells which line it. At other times the growth is more active than this, *e.g.*, the semi-malignant growth of misplaced portions of the suprarenal bodies.

If we study the comparative anatomy of the lymphatic system we find many reasons for expecting occasional lymphatic rests. In fishes[3] for instance the lymph vessels are not so plainly differentiated from the venous system as in the higher forms—a lymph sinus connected with a vein occurs on either side in the scapular region and into it lymphatic trunks from the head and body open.

Huntington, of Columbia, and McClure, of Princeton, have given much study to the comparative anatomy of the lymphatic system. The jugular lymph sac, depicted in Fig. 16, is a structure found in many animals and might well give rise to a sequestration in its development.

Professor McClure who has seen some of my specimens writes as follows:

"I think there can be no doubt about the cystic growths you speak of being due to embryonic sequestrations of lymphatic tissue.

---

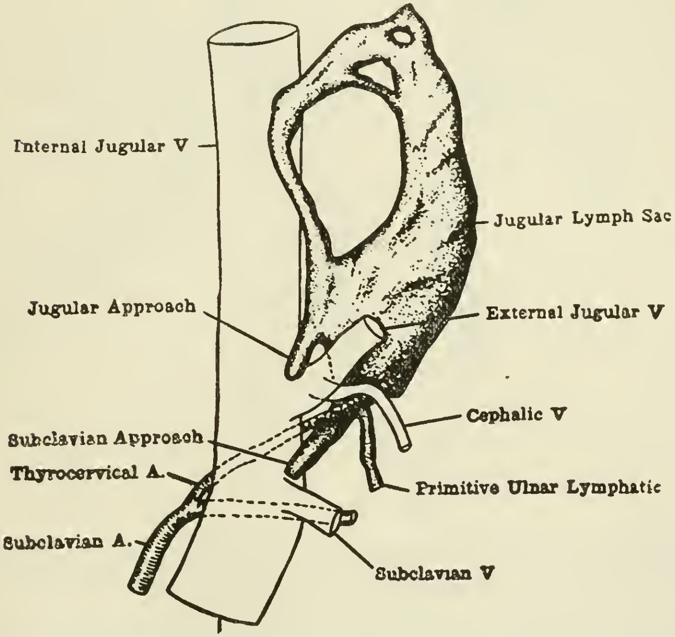
[3] Wiedersheim, Comparative anatomy of Invertebrates, MacMillan, 1907, p. 432.

"Both Huntington and I have found that the lymphatics in the neck region of mammals develop as independent structures which secondarily connect with the veins. In certain cases some of these independent structures may never join the vein and give rise to the structure you mention. I have found the same condition in fishes, so one may regard this principle of development as uniform for vertebrals in general."

Fig. 17 shows an arrangement well adapted for the production of sequestrations.

The literature of the subject of hygromas throws much light on the peculiarities of their occurrence and strengthens our belief in the method of development above given.

FIG. 16.

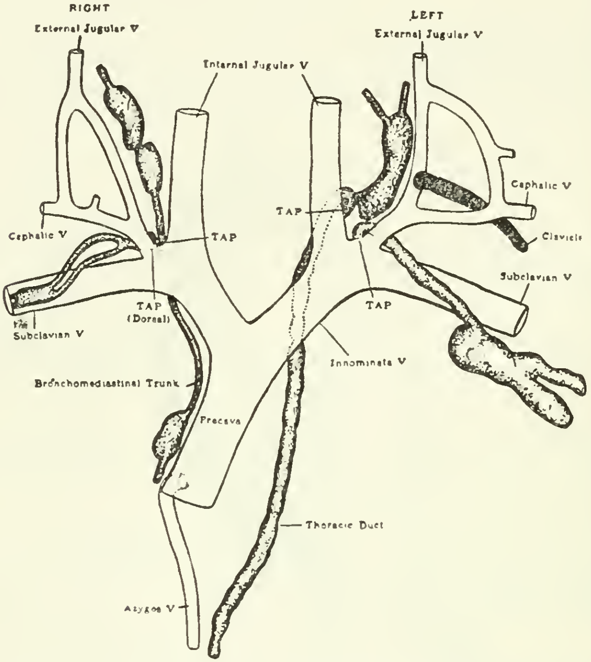


A reconstruction of the left jugular lymph sac of a 11 mm. cat embryo (*Felis domesticus*). Reproduced from Anatomical Record, vol iii, p. 535 (McClure and Silvester).

Dr. Farr has made out the following tables endeavoring to include only those cases which were definitely hygromas, according to the definition above given. It is not possible to make a list which is altogether satisfactory, *e.g.*, in only 15 of the 91 cases in the first table is there a definite statement of the endothelial lining of the cysts and we do not know how well the staining was done in most of these 15 cases.

The group division here given is about what would be expected. The neck is the part of the body most richly supplied with lymphatics and hence the most common site of these growths. The axilla which also has a rich lymphatic supply shows the next largest number. Without doubt some of the axillary growths pressed through from the neck as in the writer's second case or were associated with the neck cysts as in Case 1.

Fig. 17.



Showing the structure of the lymphatics and their communications with the veins in the Pig-tailed Macque (*Macacus nomestrinus Linn*). Reproduced from Anatomical Record, vol iii, p. 551, Fig. 9 (type 11) (McClure and Silvester).

It is a little strange that so few cases are reported in the groin but there are enough to establish their existence.

It is also noteworthy that so little of the literature is recent. Most of the recent cases are described under the

HYGROMA CYSTICUM COLLI.

Table of Reported Cases of Hygroma. Prepared by Dr. Charles E. Farr.

No.	Author	Age	Sex	R.	L.	Operation	Autopsy	Result	Contents	Uni-locular	Multi-locular	Endo-thelium	Reference
1	Arnold	1 wk.	M.	+			+	d.			+	+	Virchow., Archiv., 1865, Bd. 33, p. 209.
2	Arnold	Fœtus		+	+		+	d.			+	+	Virchow., Archiv., 1865, Bd. 33, p. 209.
3	Hawkins	8 mo.		+		Repeated puncture		c.	Fluid serum		+		Medico-Chir., Tr., 1839, v. 22, p. 231.
4	Hawkins	1 yr.		+		+		?	+		+		Medico-Chir., Tr., 1839, v. 22, p. 231.
5	Hawkins	11 wks.		+		None		d.	+		+		Medico-Chir., Tr., 1839, v. 22, p. 231.
6	Arnott	1 mo.	F.		+	Puncture and excision		c.	+		+		London M. Gazette No. 3, v. 1, 1839. p.917.
7	Nelaton	N. B.		+		Puncture and excision		c.	+		+		Gazette d' Hôpt., 1854, No. 78, p. 310.
8	Lorain	N. B.	M.	+	+	None	+	d.	+		+		Gaz. med. d. Paris, 3 Ser., T. viii, 1853.
9	Storch	4 wks.	M.		+	Punctures	+	d.	+		+	O	p. f. Kinderkrankheiten 1861., p. 68.
10	Bruch	N. B.	M.	+			+	d.	+		+	O	Zeitach. f. Rat-med., Bd. 8, p. 91.
12	Evans	1 yr.	M.	+		Seton		c.	+		+		Lond. Med. Ex. May, 1850; Handbuch der Kinderkr, 1854, p. 786.
13	Roux	3 mos.				Incision		c.					Rec. Med. chir., 1855.
14	Gilles					Excision		d.					Dissertation.Bonn, 1852.
15	Gilles					Excision		d.					Dissertation.Bonn 1852.
16	Roux J.	8 d.	M.		+	Injection iodine		c.	+		+		Bull. Gen. de Therap. v. 51, p. 455.
17	Roux J.	15 mos.	F.		+	Injection iodine		c.	+		+		Bull. Gen. de Therap. v. 51, p. 456.
11	Ebermaier	2 mos.	F.	+	+	None	+	d.	Bloody serum		+		Caspar's Wchn, 1836, p. 13.
18	Wutzer	11 d.	M.	+	+	None	+	d.	+		+		Caspar's Wchn, 1836, p. 257.
19	Völckers	14 d.	F.	+		Puncture	+	d.	Clear serum		+		Caspar's Wchn, 1837, p. 704.
20	Bednar	55 d.	F.		+	Incision	+	d.	+		+		Krankheit de Neugebor, 1850.
21	Bouchut	21 d.			+	O	+	d.	+		+		Kinderkrankheiten, 1854, p. 786.
22	Berend	12 w.		R		Puncture and iodine		Imp.	+		+		Med. Zentral-Zeit, 1861, p. 286.
23	Ebert	7 yrs.	M.			Puncture and iodine		Imp.	+		+		Med. Zentral-Zeit, 1861, p. 286.
24	Ammon	N. B.			+	O	+	d.	Red serum	O			Angeboren. Chir. Krankheit., 1842, p. 54.
25	Droste	N. B.	F.			Seton		c.	+		+		Halscheis Hannover Annal, 1839, p. 295.
26	Scholz	22 yr.	M.		+	Partial excision		c.	+	+			Wien. Med.Wochn, 1863, v. 13, p. 612.
27	Schuh	N. B. few mos.				Excision			Clear serum		+		Path. and Therap. d. Pseudoplasm, 1854, p. 196.
28	Wernher	N. B.	F.		+	Spont. rupture	+ (later)	c.	+		+		Angeborene Cystenhygrom, 1843.
29	Ammon.	1 yr.		+	+	O		Unchanged			?		Angeb. Chir. Krankheit, 1892, p. 57.
30	Redenbacher			+	+		O	d.					Diss. München, 1828.
31	Otto	N. B.	M.	+	+		+	d.	+		+		Monst. Sexcent. Vratirl, 1841.
32	Jackson	3 yrs.	M.		+	Excision		c.	+		+		Am. Jr. Med. Sci., 1861, p. 101.
33	Gurlt	Fœtus	M.	+	+		+	d.	+ ?		+		Cyst. Geschülst des Halses, 1855.
34	Gurlt	Fœtus		+	+		+	d.	+		+		Cyst. Geschülst des Halses, 1855.
35	Gurlt	12 wks.	F.	+	+	Puncture		d.	+		?		Cyst. Geschülst des Halses, 1855.

HYGROMA CYSTICUM COLLI.—*Continued.*

No.	Author	Age	Sex	R.	L.	Operation	Result	Autopsy	Contents	Multilocular	Cyst Wall	Reference
36	Bednar	N. B.	F.		+	Puncture	d.	+	Serum	+		Kranhheiten des Neugeboren, 1850.
37	Adelman	5 wk.	M.		+	Puncture and Seton	c.		Serum	+		Walther u Ammon fr. de Chir., 1850, p. 237.
38	Zangenbeck	25 yr.	M.			Excision	c.		Serum	+		
39	Koenig					Excision	c.		Serum	+		
40	Nasse	25 yr.	F.		+	Excision	c.		Serum	+	Endothel'm	Archiv. f. klin. Chir., B. 38, 1889, p. 614.
41	Nasse	19 yr.	F.	+		Excision	c.		Serum	+	Endothel'm	Archiv.,f. klin, Chir.,B.38,1889,p.614.
42	Nasse	2 yr.	M.	+	+	Excision	c.		Serum	Unilocular	Endothel'm	Arch. f.klin, Chir., B. 38, 1889, p. 614.
43	Nasse	11 yr.	M.		+	Excision	c.		Bloody serum	Unilocular	Endothel'm	Archiv.,f.klin, Chir., B.38,1889, p.614.
44	Kenerson	5 mo.		+		Excision	d.		Bloody serum	Multilocular	Endothel'm	Phil. Med. Jr., 1901, v. 8, p. 533.
45	Halstead and Herzog	22 mo	F.		+	Excision	c.		Bloody serum	Multilocular	Endothel'm	J. A. M. A., 1899, v. 32, p. 233.
46	De Quervain	Adult	F.	+						Multilocular		Spezielle Chir. Diag., 1913, p. 169.
47	Sicls	2 yr.	M.									Virchow Archiv., 1903,Bd. 72, p. 445.
48	Carless	5 yr.	F.	+		Excision	c.		Bloody serum	Multilocular	Endothel'm	Med. Press and C., 1904, v. 1, p. 140.
49	Carless	3 d.			+	Excision	d.		Serum	Multilocular	O	Med. Press and C., 1904, v. 1, p. 140.
50	Robinson	3 mos	M.	+		Partial excision	d.		Serum	Multilocular		Trans. Path. Soc., Lond., 1895–6, v. 47, p. 255.
51	Koester	N. B.		+		Puncture	d.		Serum	Multilocular	+	Wurzburger Abhand, 1872, Bd. iii, p. 44.
52	Wölfler	3 yr.	F.	+		Incision	c.		Serum	Multilocular		Wien. Med. Press, 1886, B. 27, p. 906.
53	Paetzold (Garré)	5 wk.	F.	+		Partial excision	d.	+	Serum	Multilocular		Bruns Beiträge, 1906, No. 51, p. 652.
54	Paetzold	8 mo.	F.	+		Excision	d.	+	Bloody serum	Multilocular	+	Bruns Beiträge, 1906, No. 51, p. 652.
55	Paetzold	13 mo.	M.		+	Excision	c.		Bloody serum	Multilocular		Bruns Beiträge, 1906, No. 51, p. 652.
56	Paetzold	3 yr.	M.	+		Excision	c.		Bloody serum	Multilocular		Bruns Beiträge, 1906, No. 51, p. 652.
57	Paetzold	2 yr.	F.	+		Excision	c.		Blood and ser.	Multilocular	+	Bruns Beiträge, 1906, No. 51, p. 652.
58	Paetzold	37 yr.	F.	+		Excision	c.		Serum	Unilocular	O	Bruns Beiträge, 1906, No. 51, p. 652.
59	Trendelenburg	2 yr.	M.	+		Injection-iodine	d.		Brown serum	Multilocular	O	Archiv.f.klin. Chir.1872,Bd.13 p.404.
60	Trendelenburg	9 d.	M.		+	Injection-iodine	c.		Serum	Unilocular		Archiv.f.klin. Chir.1872, Bd.13 p 304.
61	Trendelenburg	1 d.	M.	+		Injection-iodine	c.		Bloody serum	Unilocular		Archiv.f.klin.Chir.,1872, Bd.13,p.404.
62	Winiwarter	14 m.	M.		+	O	d.	Partial	Bloody serum	Multilocular	+	Archiv.f.klin.Chir.,1874 B. 16, p. 655.
63	Schwerin	N. B.	F.	+	+	Puncture of ranula	d.	+	Serum	Multilocular	No cylinder epithel'm	Archiv.f.klin.Chir., 1874, B.23, p.430.
64	Burow					Partial excision	d.					Archiv. f. klin.Chir., 1871,B.12,p.979.
65	Burow	14 m.			+	Drainage	c.		Serum	Multilocular		Archiv.f.klin.Chir., 1871, B.12, p.979.
66	Birkett	20	M.	R		Puncture repeated	Unim.		Clear serum	+		Med. Times and Gazette, 1868,ii p.79.
67	Albert	Adult	M.	R		Puncture			Serum	?		Lehr. d Spec. Chir., 1897, Bd.i, p. 216.
68	Roberts	3 yrs.	M.		L	Excision	d.		Serum	+		Phil.Med.Times, 1875, Mar.13, p.372.

69	Boinet					Injection	c.					Bull. d. l. Soc. d Chir., d Paris, 1859. x, p. 222.
70	Robert					Puncture	d.		Serum	+		Bull. d. l. Soc. d. Chir. d Paris, 1859, x p. 222.
71	Broca	N. B.		R.		Punc. and Excis.	d.		Serum	+		Bull. d. l. Soc., d Chir. d Paris, 1859, x p. 222.
72	Guillaumet	Fœtus				O		+	Bloody serum	+		Bull. d. l. Soc. anatomique, 1879, ix 582.
73	Hardie	5 m.	F.		L.	Excision	c.		Serum	+		Lancet, 1872, v. 2, p. 667.
74	Hogg	14 m.				Seton	c.		Serum	+		Lancet, 1873, v. 2, p. 812.
75	Holmes	8 yrs.	M.	R.		Excision	c.		Serum	+		Med. Times & Gaz. 1864, v. 1, p. 76.
76	Hewitt	6 m.	F.			Partial excision	c.		Serum	+		Med. Times & Gaz., 1864, v. 1, p. 76.
77	Smith	3 wk.	F.		L.	O	Imp.					St. Barthol Reports 1866, v. 2, p. 24.
78	Smith	8 m.	M.	R.		Seton	c.		Serum	+		St. Barthol Reports 1866, v. 2, p. 31.
79	Smith	3 yrs.	F.	R.		Seton	c.		Serum	+		St. Barthol Reports 1866, v. 2, p. 31.
80	Smith	Infant 6 mo.	F.		L.	Seton	c.		Serum	+		St. Barthol Reports 1866, v. 2, p. 31.
81	Dittl	2 yrs.	M.	R.	L.	Excised	c.		Serum	+		Oster. Zeitschift f. Prah, Heil, 1859, v. 81.
82	Valenla	N. B.	M.	R.	L.	O	d.	+	Serum	+		Oster Handb. f. Paediatrik, 1871, ii 35.
83	Devatz	6 m.			L.	Punctured	c.		Bloody serum	+		Bull. et Mem d. l. Soc. d. Chir. d Par. 1876, ii, 762.
84	Kumemüller	8 mo.		R.		Cautery	d.	+	Serum	+	Endothel'm.	Jahrbuch f. Kinderheit 1898, B. 48, p. 390.
85	Hofmohl	16 yrs.	F.	R.		Excised	c.		Serum	Unl. ?	Endothel'm	Archiv. f. Kinderheit 1887, viii, 220.
86	Parrot	2 m.	F.			O				+		Gaz. des Hôpit., 1880, p. 35.
87	Lannelongue	2 yr.				Puncture	d.	+	Serum	+		Gaz. des Hôpit., 1880, p. 199.
88	Kocher	3 m.				Injection-iodine	c.		Serum	+		Corresp. blat. f. Schweizer A. 1878, viii, 625.
89	Stolz	5 d.	M.	R.		Puncture	d.	+	Serum	+		Rev. Med. d L. Est., 1878 x, p. 161.
90	Lücke	4 d.			L.	Puncture	d.	+	Serum	+		Virchow Archiv. 33, 1865, p. 330.
91	Lücke	few wk.		R.		O	d.	+	Serum	+		Virchow Archiv. 33, 1865, p. 330.

HYGROMA CYSTICUM AXILLARE.

No.	Author	Age	Sex	R. L.	Operation	Result	Autopsy	Contents		Cyst Wall	Reference
									Lining		
1	Sandifort		F.	R. L.	Punctures	c.				Multilocular	Obs. Anat. path, .v. iv, p. 21.
2	Hawkins										London Med. Chir., Tr. v. 22, p. 236.
3	Tofft			R.	Puncture	c.				Multilocular	
4	James	5	M.	L.	Excision	c.		Serum	Endothel'm	+	Lancet 1891, v. 1, p. 1372.
5	Senn				Excised	c.				+	Internat. Clin., 1903, 13, s. i p. 129.
6	Nasse	5 mo.		L.	Excised	c.		Serum	+	+	Archiv. f. klin. Chir, 38, 1889, p. 614.
7	Nasse	8 yr.	F.	L.	Excised	c.		Scrum	+	+	Archiv. f. klin. Chir. 38, 1889, p. 614.
8	Nasse	2 yr.	F.	R.	Excised	c.		Serum	+	+	Archiv. f. klin. Chir. 38, 1889, p. 614.
9	Nasse	3 yr.	F.	L.	Excised	c.		Bloody serum	+	+	Archiv. f. klin. Chir. 38, 1889, p. 614.
10	Koenig	11 yr.			Excised			Blood and serum	+	+	
11	Carless	6 yr.	M.	L.	Excised	c.		Serum		+	Med. Press & C. 1904, v. i, p. 140.
12	Ribbert	10 yr.	M.		Excised			Serum	+	+	Virchow Archiv. Bd 151, p. 392.
13	Rumbold	4 d.		R.	Puncture and excision	c.		Serum	+	+	Wein klin. Wchn, 1894, No. 7, p. 531.
14	Weinher										Angeborener Cysten Hygrom, 1845, p. 488.
15	Verneuil	10 yr.									
16	Heschl	9 m.		L.	Partial excision	d.	+	Serum		+	Uber ein angeborener Cysten hygrom der achulhöhle, 1876.
16	Rumbold	9 m.		L.	Excision	d.		Serum	+	+	Weln klin. Wchn., 1894, No. 7, p. 533.
17	Rumbold	2 yr.	M.	L.	Drainage	c.					Wein klin. Wchn, 1894, No. 7, p. 552.
18	Gjorgjevic	2 m.	M.	R.	Puncture	c.		Serum		+	Archiv. f. klin. Chir., xii, 1871, p. 685.
19	Brazis	7 w.	F.	L.	Excision	c.		Serum	+	+	Bruns Beiträge, 18, 1897, p. 379.
20	Brazis	2½yr.	M.	R.	Excision	c.		Serum	+	+	Bruns Beiträge, 18, 1897, p. 379.
21	Brazls	15 yr.	F.	L.	Puncture electrolysis excision	c.		Serum	+	+	Bruns Beiträge, 18, 1897, p. 379. Bruns Beiträge, 18, 1897, p. 379.
22	Brazls	1 m.	M.	L.	O	d.	+	Serum	+	+	Bruns Beiträge, 18, 1897, p. 379.
23	Anders	2 yr.		R.	O	c.		Serum		+	Jahrb Kinderheil n. F. Bd 16, 1881, p. 429.
24	Birkett	28	M.	R.	Excision	c.		Serum			Med. Times & Gazette, 1868 v.2, p. 79.
25	Wegner	9 m.	M.	R.	Excision	d.	+	Serum		+	Archiv. f. klin. Chir. xx, 1877, p. 674.
26	Wegner	2½ yr.	F.	R.	Excision	c.		Serum		+	Archiv. f. klin. Chir. xx, 1877, p. 689.
27	Müller	1 yr.		R.	Excision	d.		Serum	+	+	Bruns Beiträges Bd. i, 1883, p. 500.
28	Riedinger	35 yr.	M.	L.	Excision			Serum		+	Deutsche Chir., 1888, L. 42, p. 251.
29	Pinner	4 yr.	M.	L.	Injection Zncl₂	c.		Serum		+	Central blatt f. Chir., 1880, p. 177.
30	Pilate	2½ yr.		L.	Excision	c.		Blood and serum		+	Bull. et Mem. d. l. Soc. de Chir. de Paris, 1878, p. 815.
31	Birkett	7	M.	R.	Excision	c.		Serum		+	Med. Times & Gazette, 1868, ii, p. 79.
32	Koenig	Few mos.						Serum		+	Lehrb. d Spec. Chir., 1889, ii, p. 40.
33	Smith	14 w.	M.	Post	Seton	Imp.		Serum		+	St. Barthol. Rep. v. 2, 1866, p. 32.
34	Smith	2 yr.	F.	L.	Seton	c.		Serum		+	St. Barthol. Rep. v. 2, 1866, p. 32.
35	Dubar	4 m.	M.	L.	Excision	c.		Bloody serum	Endothel'm	+	Bull. d. l. Soc. Anat. de Paris, 1892, p. 286.

HYGROMA CYSTICUM (GENERAL).

Number	Author	Age	Sex	R. L.	Operation		Result	Autopsy	Contents	Multi-locular	Cyst Wall	Reference
1	Paetzold	4 d.	F.	+	Thigh and leg	Excision	c.		Lymph	+		Bruns Beiträge, 1906, No. 51, p. 652.
2	Hildebrand	1 m.	F.		Rectal sacral	Excision	d.	+	Lymph	+	Endothel'm	Archiv. f. klin. Chir. B. 49, 1894, p. 204.
3	Hildebrand	3 yr.	M.		Rectal sacral	Excision			Lymph	+	Endothel'm	Archiv. f. klin. Chir., B. 49, 1894, p. 204.
4	Reichel	1 m.	M.		Left perineum	Puncture incision	d.	+	Lymph	+	Endothel'm	Virchow. Archiv. 46, 1869, p. 497.
5	Müller	2 m.	F.		Lips, tongue, cheek	Excision	c.		Lymph	+		Bruns Beiträge, 1883, Bd. i p. 498.
6	Verneuil	7 yr.			Perineum	Excision			Lymph	+		Cruveilhier Anat. Path. Gen. T. iii, 1856, p. 498.
7	M. Deguise	18 yr.	M.		Abdominal wall	Excision			Lymph	+		Bull. d. l. Soc. d. Chir. d. Paris, 1857, T, 8, p. 459.
8	Morel-Lavallié			R.	Shoulder	O		+	Lymph	+		Bull. d. l. Soc. d. Chir. d. Paris, T, 10, 1859, p. 230.
9	Smith	18 m.	F.	R. & L.	Back of neck	O	Imp.			+		St. Barthol. Rep., v. 2, 1866.
10	Smith	3 m.	F.		Dorsal spine	O	Imp.		Lymph	+		St. Barthol. Rep. v. 2, 1866.
11	Delbet	3 m.		R.	Orbital .	Excision						Bull. d. l. Soc. Anat. de Paris, 1893, p. 637.

heading of lymphangioma and it is difficult to sift out the cases which are really hygromas. Winglowski's[4] recent article should be referred to, he studied various neck anomalies and dissected 150 half necks in children and adolescents and found rests 23 times.

It would be very gratifying to explain the remarkable power of growth which these cysts have. Unfortunately we cannot do this with absolute accuracy any more than we can tell why some people grow to be large and others remain small. There are, however, many other instances of somewhat similar growth. Ovarian cysts, parovarian cysts, dermoid cysts, both abdominal and subcutaneous, hypernephromas, mesenteric cysts, thyroglossal and branchial cysts, lipomata, exostoses, growths of the carotid body, common warts are all examples of individual power of growth which comes in tissues otherwise benign. In view of these examples it is not strange that sequestrations of lymphatic tissue in the neck should occasionally show this great power of growth.

SUMMARY.—1. Cystic hygromas of the neck have been described for many years and their existence is undoubted.

2. The term should be restricted to cysts lined with endothelium and having a marked power of growth.

3. Such cystic growths are uncommon. A careful search of the literature has so far revealed records of only 91 cases located distinctly in the neck and 35 cases located principally in the axilla, but in part at least extending there from the neck.

4. The writer records three cases of undoubted hygroma and a fourth case which is believed to have been a hygroma but in which inflammation had destroyed the finer structure of the cyst walls.

5. The most satisfactory explanation of the existence of these hygromas is that embryonic sequestrations of lymphatic tissue existed and that they had the power of persistent irregular growth.

6. Excision is the best treatment. If this is impracticable partial excision is the next best.

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[4] Archiv f. Klin. Chir., 1912, vol. 98, p. 151.

EXCLUSION OF THE BLADDER, AN OPERATION OF NECESSITY AND EXPEDIENCY.*

BY CHARLES H. MAYO, M.D.,
OF ROCHESTER, MINN.

Exclusion of the bladder is an operation which has been slowly accepted by the medical profession, and while it is generally admitted that such an operation may be necessary and often is advisable, the mortality following the earlier procedures was at least detrimental to enthusiasm. However, there has been much more to overcome than mortality in the matter of sentiment and the so-called conservatism which urged the preservation of the bladder at any cost regardless of control or comfort.

The natural mortality in these cases, although high in deformities and assured in malignancy, was, at least, not the work of man. Oppel,[1] quoting Mirotworzeff,[2] gives the statistics as follows: "Seventy patients between 10 and 20 years, 10 deaths; between 20 and 40 years, 17 deaths; between 40 and 50 years, 5 deaths; one reached the age of 70 years." He states further that the natural mortality in cases of exstrophy of the bladder in children show that more than half die before the tenth year.

Within a comparatively recent period our interest in the subject has been revived by reports of many successful cases of exclusion of the bladder and with the improved technic of the various procedures. To determine the best method of disposal of the secretion of the kidneys in individuals in whom it is necessary or expedient to exclude the bladder, is still one of the serious problems of surgery. To say, however, that the modern operation exposes the patient to greater danger from infection than is compensatory with the mitigation of his suffering, together with the natural mortality of the disease, is not consistent with the history of the patients or the records of the progress of surgery in these cases. Unfortunately, many of the patients under discussion are already suffering from the secondary infective complications before operative measures are advised. The patients under discussion may be grouped under three headings (Fig. 1):

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* Read before the American Surgical Association, May 8, 1913.

(1) Those suffering from congenital anomalies of the bladder or urethra of such character as not to permit restoration with controllable urine or who cannot be relieved from painful sequelæ by local surgical or other measures.

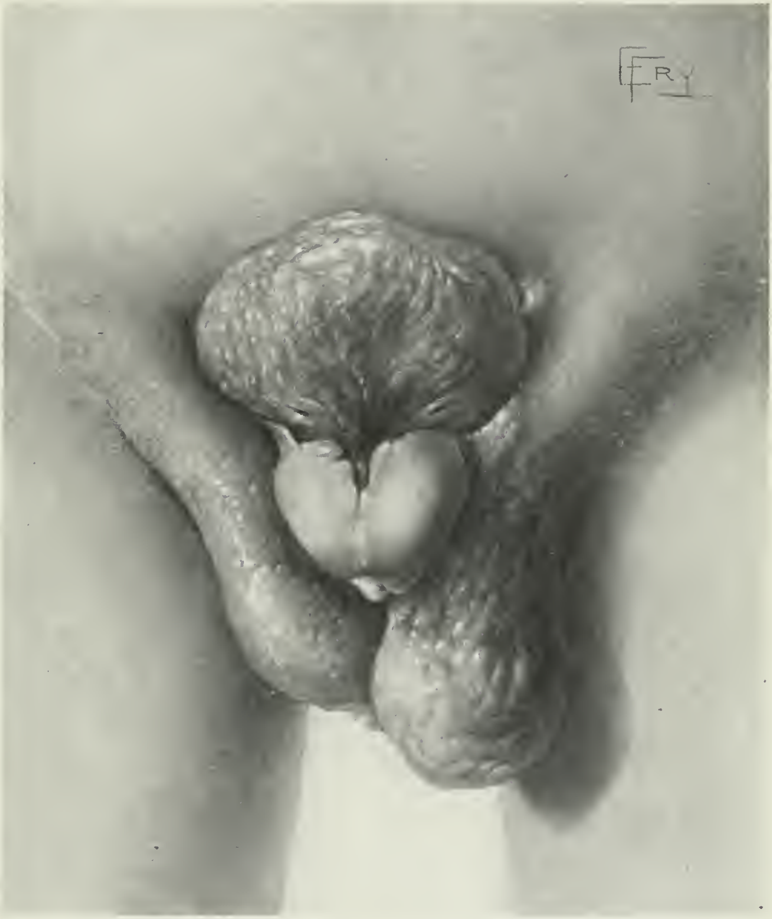
(2) Those in whom portions of the ureter are necessarily or accidentally injured or removed during abdominal, pelvic or sacral operations.

(3) Those in whom malignant disease of the urinary bladder is too extensive to permit removal by partial resection of the bladder with retentive function under control, and those in whom gross malignant or other disease of the bladder exists, but in whom the power of retention and control add to their suffering. These cases will necessarily be limited in number.

For the repair of the first group various surgeons have devised a wonderful variety of ingenious methods. Making a bladder from skin flaps was originated by Roux[3] in 1852. Various modifications have been developed by Thiersch,[4] Nelaton,[5] Wood[6] and many others. The compression of the bony pelvis (the anterior portion of which is usually missing) was instituted by Passavant,[7] the breaking and subcutaneous section of lateral bony arches were devised by Koch,[8] König[9] and others, and Trendelenburg[10] successfully accomplished the closure of the bladder, covering it with an anterior bony arch by freeing the sacro-iliac joints. Epispadias, especially in the female, which is so extensive as to cause a loss of urinary control, is also placed in this group, although a few of these cases may be benefited by local measures.

Excellent results have been claimed for the Goebel[11] method of providing a voluntary sphincter made from the pyramidal muscles. Ssubbotin's[12] method, in its effort to develop a bladder with control of the sphincter, is probably the most ingenious. It is especially applicable in males. An anterior incision is made within the anus, the space in front

Fig. 1.



Exstrophy of bladder in male. Exposed mucosa with ureteral openings.

of the rectum and within the sphincters is tunnelled up to reach the base of the bladder, a rectangular strip, of which the future urethra is made, is drawn down to protrude from the anal ring in the fore part of the rectal opening. The remainder of the bladder and the anterior part of the rectum is converted into a closed pouch, the control of which is contained in the rectal sphincter. The operative mortality in these cases is 25 per cent. and should the technic fail the patient is exposed to the loss of control of both bladder and bowel, since no other operation is then possible. The new bladder is exposed to infection by all the intestinal flora through its short urethra. The plan of Gersuny [13] involved the same principle of utilizing the anal sphincter to control the open end of a separated loop of bowel to which the ureters were attached.

The objection to any method of operating for the repair of these defects which does not control urine automatically is a very serious one. Uncontrollability of the urine is only accepted by the patient who acquires the condition as the lesser of two evils—a greater one being the pain due to its retention or delivery. If an uncontrolled bladder be made from an exstrophy the patient is no better off, and, if anything, worse than a high epispadias, since the more perfectly an uncontrolled bladder is developed the more surely will it become infected or filled with stone or phosphatic concretions from the decomposing urine. He thus becomes more liable than before to an ascending infection and develops conditions which require the reopening of the bladder.

The cloacal condition, which exists normally in fowls and is also the condition which exists during the first weeks of the human embryo, early suggested the thought of making such a deflection of urine through the rectum. Such a method secured a retentive space under control, and was comparatively easy of accomplishment.

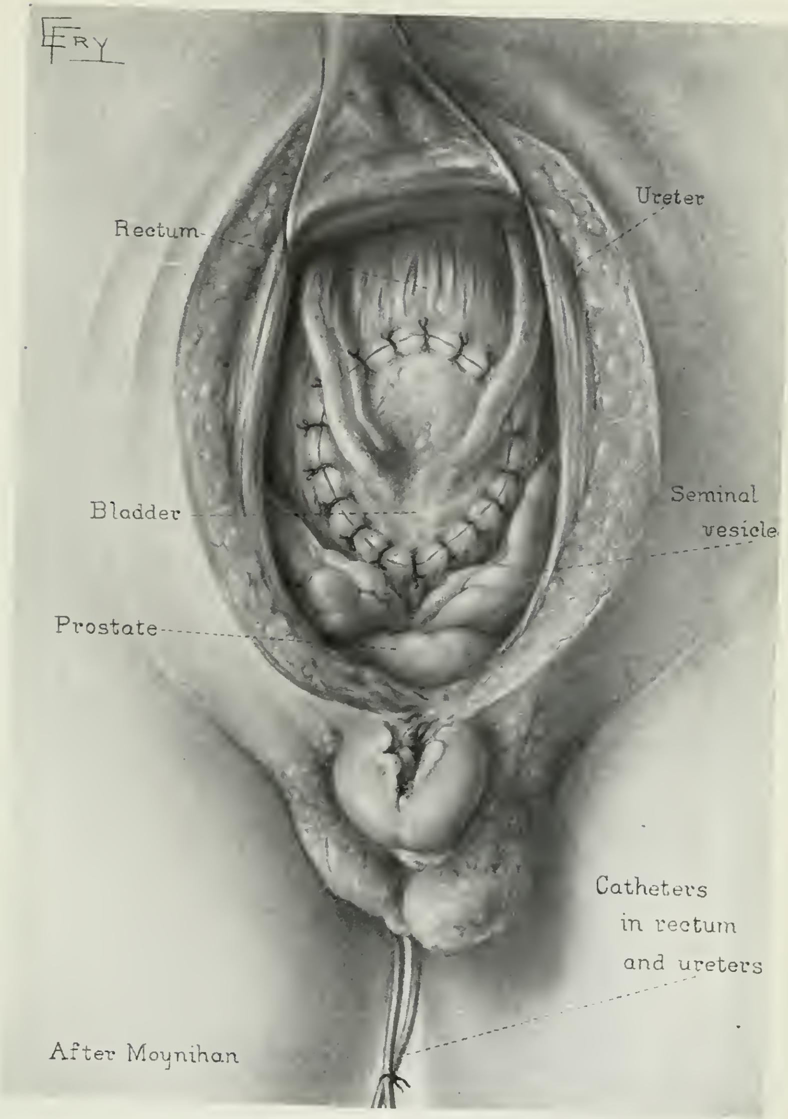
The high mortality from ascending infection of the kidneys through the ureters following the old methods of intestinal union made the procedure almost prohibitive, especially when complications were increased by shock and peritonitis.

Some of these patients were already debilitated by the infection of one and sometimes both kidneys or their pelves. Woolsey[14] reported stones in both ureters in a case of exstrophy of the bladder and a patient with epispadias, having stones in the kidney, was observed in our clinic.

In order to obviate these risks in cases of exstrophy, Maydl[15] (1892) removed the base of the bladder with the ureters attached and transplanted the segment into the rectum as a transperitoneal operation, the ureteral openings being considered as the valves. Other surgeons have projected the area of bladder into the rectum extraperitoneally, the wall of which was closed around the ureters or it was transposed and sutured into the incised rectal wall of which it became a part. Since the majority of the patients in this group are males, they lend themselves readily to such treatment. Russian surgeons, using Maydl's method, report 32 per cent. mortality. Orlow[16] reports 17 cent. mortality in 61 cases and Drucbert's[17] analysis of 81 cases gave 27 per cent. of deaths within 15 days of the operation.

More recently Moynihan[18] has converted much larger areas of the bladder into the wall of the rectum, thus increasing its capacity (Fig. 2). This operation was varied by Lendon,[19] Peters,[20] Sherman,[21] and others by removing the ureters from the wall of the bladder including a small area of attached mucosa which is projected into the bowel. These operations were usually performed extraperitoneally, though Jaja[22] converted the method into an intraperitoneal one. In reporting several cases done by the Lendon-Peters method, Buchanan[23] credits Bergenhem[24] of Nykoeings with having antedated them by five years (1894). The posterior operation has been performed by Knaggs[25] through the Kraske[26] sacral resection. Various methods of uniting the base of the bladder or ureter with the anterior rectal wall have been devised, for example, the Boari[27] spring button to develop a permanent vesicorectal fistula within a small closed bladder or a ureteral-rectal one by suture, or by the necrosing due to the pressure of forceps. Some surgeons have aimed at half a loaf, by extirpating the bladder after having united the ureters

FIG. 2.



Segment of bladder with ureters inserted into anterior rectal wall.

with the vagina as did Pawlik,[28] Sommers,[29] Chavasse,[30] and others, or with the inner end of the urethra, as done by Sonnenburg.[31] Interesting and ingenious methods have been advocated by Rutkowski[32] and other observers, for example, developing bladders from portions of intestine which are separated from the fecal flow by double section and closure with anastomosis of proximal and distal ends of intestine. The new bladder is supplied by its attached mesentery, and the ureters are anastomosed with it. Connell[33] showed experimentally that unilateral attachment of the ureter was simple, but fatal if the second ureter was also united.

In case the cæcum is thus employed, as in a case reported by Makkas[34] (1910), an appendicostomy is made through which the urine is drawn by a catheter passed at regular intervals of a few hours. Surgeons have endeavored to develop a form of cloaca by section of the sigmoid several inches above the rectum, closing the distal end and anastomosing the proximal end to the bowel just above the rectum. The ureters are then attached to the blind extremity, thus aiming to avoid direct fecal contamination. While the urinary flow may wash out the regurgitant fæces, the natural tendency of attached sections of the bowel, out of circuit, is to impact and in that event the desired result would not be obtained.

In the second group of cases are those in which something must be done with the injured ureter when it cannot be reunited to itself or reattached to the bladder, as will occur in the occasional case. The injured ureter may be reunited with the other ureter if that is patent, or one or both ureters may be united to the colon. Mirotworzeff and Tichow[35] believe that it is best to unite the ureters to the pelvic colon and that evacuations should be fairly frequent to avoid absorption. Berg[36] demonstrated that when the urine traversed the entire length of the large bowel urinary intoxication occurred, which would indicate that the methods used to unite an injured ureter to the end of the appendix are more ingenious than practical, offering no advantages over older methods which have failed. This is also true of the technic used in

Fink's[37] fatal case in which the base of the bladder exstrophy was united to the appendix.

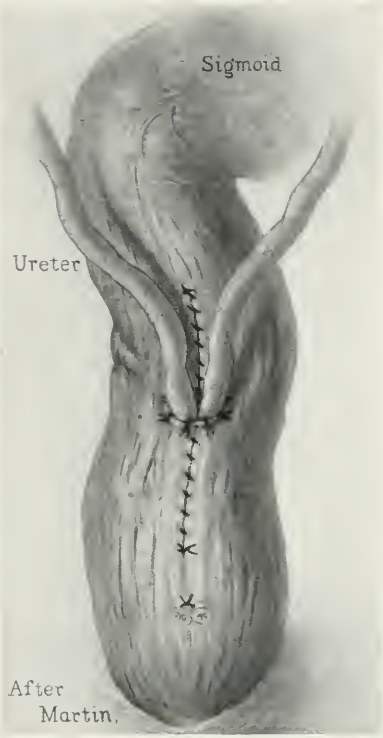
Under some circumstances, the remaining kidney being healthy, one ureter may be tied, causing the death of the kidney. Many observers believe that by whatever method the ureters are attached to the bowel they will frequently transmit infection to the kidney or its pelvis. In this connection Oppel's report is interesting, showing that some pyelitis is common following ureteral anastomosis and that autopsies made years afterward show that the conditions may clear up without a trace of their effects on the kidney.

Direct drainage of the urine to the skin was advised by Ballance and Edwards[38] in 1886. This has also been accomplished by pelviotomy and by Watson's[39] nephrostomy. In 1896 Harrison[40] performed the operation and deflected the ureter to the skin of the loin after tying the other ureter. The method was later repeated on both ureters by Bottomley[41] and also by Rovsing[42] without their knowing of Harrison's work. These operations were done both transperitoneally and extraperitoneally, the urine being collected by special apparatus. The operation is a simple one and can be done in two stages, that is, one kidney or one ureter at a time; the bladder being dealt with or not, according to the condition present. Bovee[43] has collected 13 cases of cutaneous ureterostomy.

The patients in the third group, namely, those having malignant disease of the urinary bladder, form an interesting and complicated series. Transplanting one ureter into the bladder is no longer a rare operation. Such procedures are satisfactory for the suitable case, in which a controllable bladder will be retained, but other methods are necessary for those patients in whom all of the bladder must be removed or in whom life can be prolonged and comfort secured even though the condition be too far advanced locally or by metastasis to warrant radical procedures.

Tichow and Grammatikati[44] report 61 cases of neglected cancer of the uterus in which the vagina, bladder, uterus and

Fig. 3.



Double implantation of ureters. (After Martin.)

lymphatic glands were removed and the ureters implanted into the rectum. The mortality was 30 per cent.

The history of the various attempts to transplant the ureters to the bowel is a long one. From a perusal of the voluminous literature on the subject it would appear that the best theoretical and practical operations, when they can be employed, are those which permit the ureters to traverse some distance between the mucosa and outer wall of the bowel before penetrating its lumen or are infolded by the wall of the bowel for a space, and next those methods in which the base of the bladder is transposed and made a part of the rectal wall.

Ureterostomy and nephrostomy to the back is a procedure which may be recommended for special conditions, such as a diseased colon, advanced cancer of the bladder, or of double tuberculosis of the kidney and bladder.

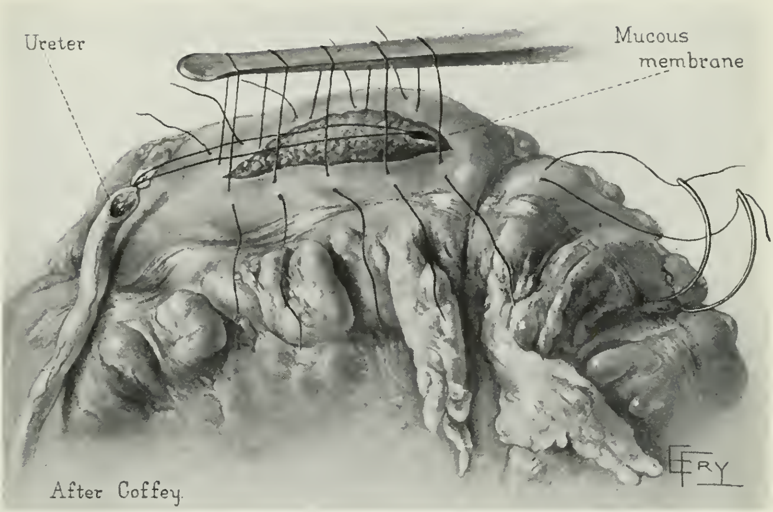
In the year 1790 Petit[45] called attention to the valve-like openings of the ureters, and it is nearly a half a century since ureteral-rectal and vesicorectal anastomoses were made by Simon,[46] followed later by Lloyd[47] and Johnson.[48] The variety of the valve type of operation was also reported by Fowler[49] (1898), Martin,[50] Carl Beck[51] (1899), and later by Frank.[52] Coffey[53] has made an extensive investigation concerning the valve function of the duct openings of both the common duct of the liver and of the pancreas. He has proved experimentally and mechanically that the valve effect is caused by the extension of the duct for some distance between the mucosa and the muscularis (Fig. 3).

Cabot[54] has shown that the ureter is similarly placed in the wall of the bladder for a distance of one to one and one-half centimetres. Direct transplantation of the ureters failed in not providing for compression of the ducts by internal pressure, thus permitting dilatation of the ureters and regurgitation into them. The method of transplanting the base or a great portion of the bladder into the wall of the rectum is practical, as it then becomes subject to the same internal tension as the rest of the intestine. This method is not difficult of accomplishment in the male.

Those operations in which the ureters are transplanted and have been preserved to their tips are correct only in principle if they are made after one of the methods which secures compression of the lumen.

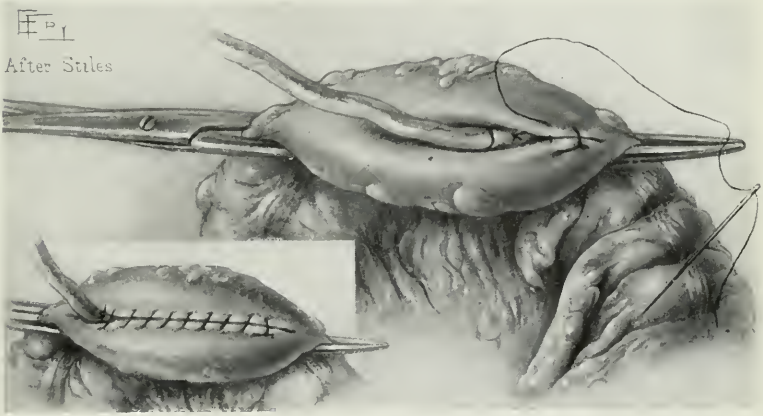
The Coffey operation, practically a divided Martin, is accomplished by separating the ureters that have been isolated and brought through the posterior peritoneum, the distal ends being ligated and buried. A double needled ligature is attached to the split ends of each ureter. At a point as low as convenient the sigmoid is held in a curved rubber-covered clamp to protect against the discharge of intestinal contents. The bowel is then incised longitudinally for one and one-quarter inches through the peritoneum and muscularis, but not the mucosa; the mucosa is perforated at the lower end of the incision. The two needles are passed into the lumen of the bowel through the opening and out of its wall, slightly separated, one-half inch lower down, and are used to draw the ureter through the opening into the lumen, where it is held by tying the two threads. The cut muscularis and peritoneum is now closed over the ureter in the incision by two rows of sutures (Fig. 4). The second ureter may now be attached or preferably the operation delayed for a later period. The Stiles operation (1907) and that of Mirotworzeff, which method is nearly the same and was reported in 1910, secure much the same effect by infolding the bowel over the ureter by numerous sutures, like a Witzel gastrostomy. The deflection of the ureters into the back, as described by Bottomley, is accomplished by a lateral incision, similar to that made in the extraperitoneal operation for stone in the ureter. The ureter is divided, the lower end ligated and the proximal end brought out of the small incision posteriorly and an inch or more above the crest of the ilium, where it is sutured to the skin. This operation has been performed in our clinic from within the abdomen. If indicated at all, we consider this method more applicable for double tuberculous disease or advanced malignancy than to anastomose the ureters with the intestine. Should there be a tendency to close, these openings can be maintained by the use of meatus dilators. Satisfactory urine

Fig. 4.



Method of incorporating ureter into large bowel by the division of the peritoneum and the muscularis. (After Coffey.)

Fig. 5.



Infolded ureter in large bowel similar to Witzel gastrostomy. (Stiles's method.)

collectors are easily adjusted by means of a belt (Fig. 5).

Concerning the dangers of necrosis of the ureters: The work of Margarucci[55] Monari,[56] and also that of Kobylinski[57] show that they may be freely separated for several inches without danger of necrosis if left free from tension.

In 1878 Smith[58] transplanted the ureters into the colon in a case of exstrophy. He noted the intermittent peristaltic delivery of urine from the ureters, and Kelly[59] has observed that when handled or irritated the peristalsis is stimulated. This point is of value in searching for the ureter within the abdomen. Scratching across the peritoneum over the supposed ureter proves it to be such if the peristaltic wave is seen, since the pelvic portion of the ureter is intimately attached to the posterior peritoneum, which should be remembered in locating them in low extraperitoneal operations.

In our cases of ureteral colonic implantation we have followed Stiles's plan of doing the operation in two stages with an interval of from one to three weeks between. It has been our experience that these operations are not satisfactory in children who are too young to attend to their own bowel movements. The control will be more difficult to secure primarily in these cases, and for a time they will require more frequent attention than before the operation.

Oppel's suggestion to try milk diet after Metchnikoff's[60] plan of reducing the intestinal bacterial flora is undoubtedly a good one in the preparation of these patients. Oppel depends also on the functional test of the kidneys by giving a hypodermic of indigo carmine, which he considers satisfactory if the urine shows blue in 15 or 20 minutes. Phenolsulphonephthalein is used as a functional test of the kidney in cases examined in our clinic.

It is hardly necessary to state that the colon should be free from disease when anastomosing the ureters with it. Another point to be remembered in operations on the large bowel is that a laxative should be given two days preceding the operation in order that the contents may again become solid.

In the second group, or cases of injured ureters, it is often possible to implant the ureter into the bladder by the

Coffey or Stiles[61] method, a procedure we accomplished in 8 cases of cancer of the bladder involving one ureteral area. The cancers were removed transperitoneally, transplanting the ureters to the opposite side of viscus while it was open. There were three cases of removal of the bladder for cancer. In one, a female, aged sixty-two, the ureters were transplanted into the rectum by the Stiles method. In spite of a defective kidney and dilated ureters there was a good operative recovery, but sudden death occurred some weeks later from cerebral hemorrhage. In one, a female aged twenty, the ureters were transplanted into the urethra by the Sonnenburg method. This patient made a primary recovery, and died one year later from acute infection of the kidneys. In the third case, a male, aged fifty, the bladder was removed transperitoneally, bringing the ureters into the back. This patient continues in good health, doing farm work for more than three years. In four cases of exstrophy of the bladder in which the organ was removed the ureters were transplanted into the rectum and lower sigmoid by the Coffey method without mortality. Except in children, a day control of from 3 to 5 hours and an all-night retention may be obtained by this method.

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ANNALS OF SURGERY

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ORIGINAL MEMOIRS.

THE SURGERY OF THE PANCREAS.*

I. INJURIES TO THE PANCREAS IN THE COURSE OF OPERATIONS ON THE STOMACH.
II. INJURIES TO THE PANCREAS IN THE COURSE OF OPERATIONS ON THE SPLEEN.
III. RESECTION OF HALF THE PANCREAS FOR TUMOR.

BY WILLIAM J. MAYO, M.D.,
OF ROCHESTER, MINNESOTA.

THE deep situation of the pancreas renders it difficult to obtain correct knowledge of its diseases during life. The little knowledge which is obtained is due chiefly to the individual experience of various surgeons and to experimental investigations.

The pancreas is derived from two or three buds from the foregut and early in fetal life is an intraperitoneal organ. When rotation takes place the pancreas is turned on its right side, losing its posterior peritoneum, which becomes converted into fibrous tissue. Possibly the diffuse character of fat necrosis both within and without the peritoneal cavity from pancreatic perforation can be accounted for in this way.

The pancreas receives its blood supply from five or six different sources, the most important of which are the superior pancreaticoduodenal, the inferior pancreaticoduodenal, the inferior pancreatic and the branches that are derived from the splenic artery as it runs behind the superior border of the body of the pancreas. The lymphatics of the pancreas are not collected in one group but follow the vascular supply—an important fact in connection with the causation of pancreatitis, as pointed out by Deaver.[1]

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The pancreas has no true capsule but, when irritated, one quickly forms from the peritoneum and those tissues derived from the peritoneum (Fig. 1).

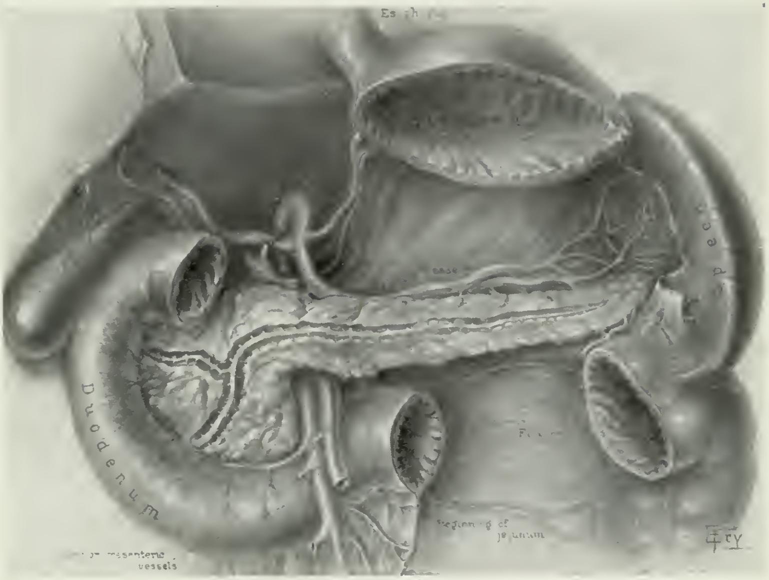
The pancreas is hidden by the liver, duodenum, transverse colon and especially by the stomach. The two latter organs vary in position to a considerable extent. Access to the pancreas for operative purposes is usually best obtained through the gastrocolic omenta, drawing the stomach upward and the transverse colon downward. The pancreas, especially the head, is usually fixed in position, but it may be more or less movable in the body and tail. During routine abdominal operations patients are occasionally seen in whom the pancreatic attachments are so loose that the pancreas as a whole can be drawn outside the abdominal cavity.

I. INJURIES TO THE PANCREAS IN THE COURSE OF OPERATIONS ON THE STOMACH.

Haberkant[2] reported a mortality of 76 per cent. in his cases of resection of the stomach for cancer in which there were pancreatic attachments resulting in injuries to the pancreas. Mikulicz[3] found a mortality of 70 per cent. in his cases when the pancreas was injured as against 27.5 per cent. when it was not injured. In 448 resections of the stomach for benign and malignant diseases up to Dec. 31, 1912 (W. J. and C. H. Mayo) the average mortality was 10 per cent. In about 8 per cent. of these cases the pancreas was injured and the average mortality was 11 per cent.

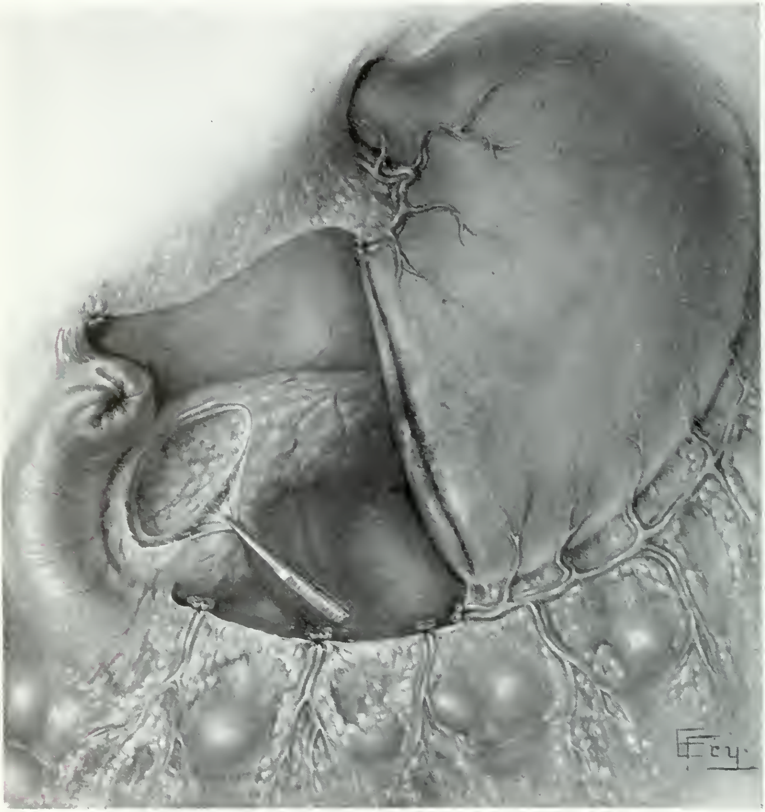
In none of these operations, however, was the main pancreatic duct reached, usually only a superficial piece was removed from the surface at a point where the pancreas was adherent to the diseased stomach. The bleeding was usually free and best controlled by catgut on a curved needle. It was noted that in these cases the pancreas had a fibrous capsule, the result of the localized peritonitis.

FIG. 1.



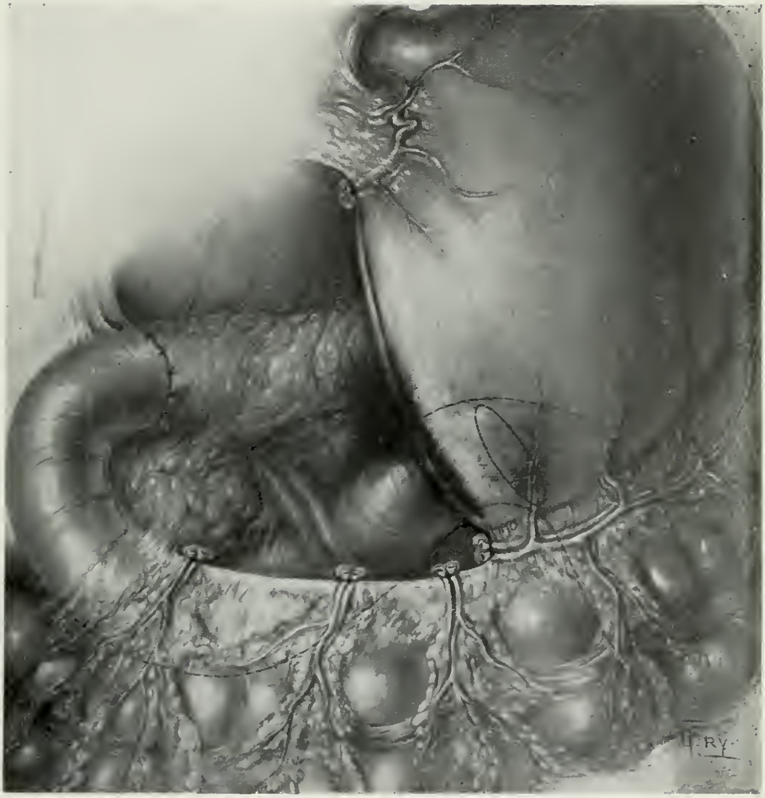
Showing anatomy of pancreas and its anatomic relations.

FIG. 2.



Showing excavation in pancreas following resection of pyloric end of stomach with pancreatic involvement. The end of stomach and end of duodenum both closed.

FIG. 3.



Showing operation completed. Closed end of duodenum buried in excavation in pancreas.

After removing the pyloric end of the stomach for cancer we close the end of the duodenum with two superimposed purse-string sutures and then apply the closed duodenal stump directly to the wound in the pancreas, as suggested by Willy Meyer.[4] The anterior peritoneum and adventitious sheath of the pancreas is then sutured to the anterior surface of the duodenum. We have used this method for something like six years and have not had leakage in a single instance either from the duodenum or the pancreas.

Fig. 2 shows the end of the duodenum closed by purse-string sutures and the vessels tied in the excavation in the pancreas. Fig. 3 shows the end of the duodenum fastened in the wound in the pancreas.

Ulcers of the posterior wall of the stomach often perforate and become attached to the pancreas. In a previous paper I described a method of transgastric excision of such ulcers.[5] These ulcers usually form an excavation into the body of the pancreas and it is necessary to excise them cleanly well down into the pancreatic tissue, leaving no area of infection. This opening cannot be closed by sutures and after stopping the hemorrhage with catgut on a needle, a piece of the gastrohepatic or gastrocolic omentum is mobilized and turned into the excavation in the body of the pancreas, being held in place by catgut sutures. In our earlier cases we used a drain of folded rubber tissue but abandoned it as unnecessary since no drainage followed.

II. INJURIES TO THE PANCREAS IN THE COURSE OF OPERATIONS ON THE SPLEEN.

In 31 splenectomies performed in our clinic the tail of the pancreas was injured three times, owing to the fact that the tail passes with the splenic vessels well up into the hilum of the spleen. In performing splenectomy the spleen is withdrawn from the abdomen, the adhesions to the diaphragm and region of the left kidney are separated and a rubber-covered clamp of the Lower variety is used to catch the entire pedicle. The tail of the pancreas is often so closely incorporated with the pedicle of the spleen that it occasionally is injured. This occurred in three of our cases.

In one case about one and one-half inches of the tail of the pancreas was found attached to the removed spleen and the pancreatic duct was plainly visible in the ligated stump. After covering the stump with peritoneal tissue and attaching a drain (which was unnecessary since no drainage followed) it was allowed to drop back into position. The patient recovered.

In the second case the tail of the pancreas was found tied in the pedicle about an inch from the tip. Since the case was one of splenic anæmia and the patient in poor condition, the stump was allowed to drop back in this condition. The patient recovered. The third case (A77736) was a male, aged twenty-six years, in whom a diagnosis of splenic anæmia had been made. At operation (January 14, 1913), the spleen was found to be of great size, extending well to the right of the median line and down to the brim of the pelvis. On account of the adhesions it was unusually difficult to remove the spleen from the abdominal cavity. The clamp was applied and the organ cut away. Catgut ligatures were applied to the splenic pedicle in sections. As the ligatures were tightened on the splenic artery, which was large, tortuous and atheromatous, it cut through and, with a gush of blood, dropped down behind the pancreas. It was caught with the fingers and compressed against the body of the pancreas while a second ligature was applied. This cut through also and it was evident that the splenic vessels would not maintain direct ligature. A double catgut strand was therefore placed around the entire body of the pancreas about three inches from the tail including the splenic vessels, the pancreas being used to strengthen the walls of the vessels. The pancreatic tissues were considerably crushed as the ligature was pulled taut. The hemorrhage was controlled immediately but as softening of the pancreatic tissue with loosening of the ligature was feared, a second ligature was applied in the same manner but one inch further to the right. It is probable that complete separation of four inches of the pancreas from the head and remainder of the body occurred. The patient made a good recovery and left the hospital in two weeks.

Coffey[6] demonstrated experimentally that tying the pancreatic duct with or without the surrounding pancreatic tissue would not permanently occlude the pancreatic duct, that the duct would regenerate and reunite within a few days. While the duct itself was not actually tied, the pressure of the ligatures about the pancreas must have been sufficient to mechanically obstruct its lumen. The abundant supply of blood from numerous sources prevented serious damage to the nutrition of the portion of pancreas cut off by the pressure of the ligature.

III. RESECTION OF HALF THE PANCREAS FOR TUMOR.

Case No. A68699.—J. L., female, aged thirty-seven years. Date of operation, June 15, 1912. History of severe attacks of pain extending into the left abdomen, and left lumbar region so severe at times as to necessitate the use of morphin. At no time, was the patient free from pain. Point of tenderness over the region of the body of the pancreas. Loss of weight, 17 pounds. Duration of illness, 3 months. Contents of stomach, stools, blood, and X-ray negative. Tentative diagnosis, cholelithiasis with pancreatic involvement. An exploratory incision was made two inches to the right of the median line in the upper rectus muscle. There were no gall-stones but a hard, irregular tumor the size of an egg was found in the body of the pancreas about its middle. A second working incision was made through the upper rectus muscle three inches to the left of the median line. The gastrocolic omentum was divided, the stomach drawn upward and the transverse colon downward. The body of the pancreas and the tumor were brought to the surface as well as possible. It seemed best to begin at the tail and remove the left half of the pancreas with the tumor. This proved to be a difficult procedure since the entire pancreas was deeply placed and fixed in position. One of the deep veins was injured and a free hemorrhage occurred which was difficult to control without injury to the splenic vessels. Finally the tail and body of the pancreas with the tumor, about 4½ inches in all, was separated, a strong clamp applied across the body one inch to the right of the tumor and the left half of the pancreas with the tumor cut away. Four clamps had previously been attached to vessels in the deep portions of the wound. An attempt was made to tie off one of these clamps with catgut on a needle, and a fresh point of bleeding which required another clamp was the result. The handles of the five clamps and the handles of the clamp previously placed across the body of the pancreas were brought to the surface and the cavity from which the pancreas had been removed was packed loosely with gauze. On the fourth day the clamps were loosened and on the fifth day they were removed. The gauze was removed on the tenth day. The patient made a good recovery, regained her normal weight and remains well. The tumor, which had the external characteristics of a malignant growth, proved on section to be a benign thick-walled trabeculated cyst buried in sclerosed pancreatic tissue.

Resections of the pancreas for tumor have seldom been made, although as far back as 1884 Billroth[7] removed the pancreas for an adenocarcinoma with recovery of the patient. Finney[8] collected 16 cases from the literature in which the pancreas had been removed for tumor, and he reported a most interesting one of his own. There were 9 recoveries and 8 deaths in the series. All of the fatalities occurred in cases of resection for malignant disease. In Finney's case and in two others, a complete resection including the tumor was made and the divided ends of the pancreas resutured with recovery of the patients.

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PANCREATIC AND PERIPANCREATIC LYMPHANGITIS.*

BY JOHN B. DEAVER, M.D.,
OF PHILADELPHIA.
Surgeon in Chief, German Hospital; Professor of the Practice of Surgery, University of Pennsylvania.

AND

DAMON B. PFEIFFER, M.D.,
Assistant Surgeon to the University Hospital and to the Out-Patient Department, German Hospital; Instructor in Surgery, University of Pennsylvania; Pathologist to the German Hospital; Director of the Clinical Laboratory, Presbyterian Hospital.

The pathogenesis of the inflammations of the pancreas is a subject of not only academic interest, but of extreme importance in the therapy and prevention of these affections. Clinical observations and experimental work have made it sufficiently clear that the various phases of acute and chronic pancreatitis depend on no single factor or set of factors. The underlying causes may be summarized as circulatory disturbances, toxæmias, obstructions of the excretory duct or ducts, and bacterial infection. Any one or any combination of these agencies may result in more or less acute or chronic damage to the parenchyma of the pancreas with accompanying alterations of its stroma, vessels, and ducts.

From work already done it has been determined that infection and duct obstruction are the two most important causes of pancreatitis. In the majority of cases, moreover, pancreatitis is not a primary condition, but occurs secondarily to some other focus of disease within the abdomen. Cammidge (*Lancet,* June 3, 1911) states that in 414 cases of which he has notes the pancreatic condition was secondary to some morbid condition of the digestive tract in 211 (51 per cent.). In 37 per cent. it was associated with disease of the biliary apparatus, chiefly gall-stones. Robson has reported that he found the pancreas involved to a greater or less degree in 60 per cent. of the cases of common duct cholelithiasis. Kehr,

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Mayo, Moynihan, and many other surgeons of wide experience in abdominal work, agree that this association is a frequent one, even though the figures given by different men as to the percentage of incidence vary rather widely in accordance with the personal equation in the interpretation of the findings at operation. Even post-mortem statistics may be cited to show the extent to which pancreatic lesions are dependent upon disease of the biliary tract. In McGlinn's study of 8515 post-mortem examinations made at the Philadelphia General Hospital, the pancreas was found diseased in 382 instances (0.4 per cent.). When gall-stones were present (506 cases) the pancreas was diseased in 66 cases (11 per cent.). These lesions were of the more marked variety, including tumors and the outspoken forms of pancreatitis. The lesser grades of pancreatitis, noted at operation, are not noted in this series.

Our own experience coincides with that of others in this respect and in addition we have been impressed by cases in which a similar relation appeared to exist in conjunction with diseases of the pylorus, the duodenum, and the appendix.

The following case is one of several that exemplify the association of pancreatitis with chronic duodenal ulcer:

Case I.—J. W., aged sixty years, a farmer by occupation, was admitted to the German Hospital, April 23, 1913.

Chief complaint, dull pains in the epigastrium and nausea.

Present Illness.—Has been suffering from "dyspepsia" for past thirty years—pains in the epigastrium about the middle of the afternoon, relieved by the evening meal, pain again near midnight, again relieved by food. Has been troubled by belching and water brash. Baking soda relieved immediately. Has had periods of months when he was free from all symptoms. Ten years ago had an unusually severe attack lasting ten weeks, with nausea and vomiting, and severe epigastric pain three to four hours after eating. After this attack he felt better than ever before for the next four years. The past two months following an attack of "La Grippe" his condition has grown worse. He has vomited for the past week, at first several hours after eating, with relief of pain, and later immediately on taking food. The pain is referred to back. He vomited a little blood several times, from straining, he thinks. He has lost 20 pounds in the last year. Feels strong.

Family and social history, negative. Had typhoid fever at ten years of age.

Physical Examination.—Anæmic looking old man. Poor musculature. Sclerotic arteries.

Chest: Negative.

Abdomen: Slight fulness in the epigastrium and lower abdomen. One tender spot in the epigastrium about two inches above the umbilicus, in the midline. No tender spot in back. Left inguinal hernia.

Blood pressure: Systolic, 164; diastolic, 110.

Laboratory Findings.—Blood count: Hæmoglobin, 69; red blood corpuscles, 4,580,000; white blood corpuscles, 8700; polymorphonuclear neutrophiles, 65; lymphocytes, 25; large mononuclears, 10.

Test breakfast: Quantity, 210 c.c., 800 recovered; occult blood, strongly positive to benzidine, faintly positive to guaiac; free HCl, 57; total acidity, 85.

Microscopy: Much undigested and partially digested starch. Much free fat. Epithelium.

Full meal (removed after 7 hours): Quantity, 75 c.c.; occult blood, positive to benzidine and guaiac; free HCl, negative; total acidity, 18; lactic acid, negative.

Microscopy: A little free fat; much undigested starch; epithelium.

Stool: Bile, faintly positive; occult blood strongly positive to benzidine; negative to guaiac.

Microscopy: Some free fat globules; vegetable fibres and granular debris.

Fluoroscope with bismuth (80 grammes).

Stomach neither dilated nor ptosed. Lower border is high midway between umbilicus and ensiform. Very poor peristalsis.

Operation (April 28, 1913).—Upper right rectus incision. The second portion of the duodenum is the site of a healed ulcer. The head of the pancreas is enlarged and compresses the duodenum. It shows the appearance of chronic inflammation and does not suggest malignancy. The peripancreatic tissues are thickened and the regional lymph glands are enlarged. The duodenum was plicated over the site of the ulcer and a posterior gastro-enterostomy performed.

Fitz laid stress upon chronic duodenitis as a factor in the production of pancreatitis. Alcohol, which is of some importance as a predisposing factor, probably exerts its influence through the production of gastroduodenal catarrh.

Robson reported that among 46 cases of interstitial pancreatitis with gall-stones or other removable cause there were five where the pancreatitis was associated with duodenal ulcer.

We have previously pointed out that pancreatitis is more common in men than in women, the reverse of what is true in biliary disease. This fact casts doubt upon the origin of pancreatitis through the medium of infection from the biliary tract, but readily parallels the greater frequency of gastroduodenal catarrh in males. We have observed that the duodenal ulcer when it is situated at its usual point of predilection, just distal to the pyloric ring, is less apt to be complicated by pancreatic involvement than when the ulceration is in the second portion of the duodenum in closer relationship to the pancreas. We are not speaking now of the cases of chronic perforation of the duodenum by which the ulcer eventually comes to make its bed in the tissues of the pancreas, but of those cases of non-perforating ulcer in which the route of transference of the infection to the pancreas is not so obvious.

In what manner does the pancreas become involved secondarily to infection of other portions of the digestive tract? During the past year and a half we have been noting this condition of the pancreas and its surroundings particularly with this question in mind. We have observed a large number of cases of pancreatic involvement prior to this date, but as our interest in the particular variety of etiology with which this paper deals began about that time we have considered only the more recent cases. The relationship of the appendix to pancreatitis we have not had the opportunity to investigate, not feeling justified in making an upper abdominal exploration during the course of an appendectomy.

During this time the pancreas has been investigated in the following cases and found involved or uninvolved, as indicated in the following table:

	No. of cases.	Pancreatitis present.	Pancreatitis absent.
Cholelithiasis	99	40 (40.4 per cent.)	59 (58.6 per cent.)
Cholecystitis	14	9 (64.2 per cent.)	5 (35.7 per cent.)
Duodenal ulcer	16	2 (12.5 per cent.)	14 (87.5 per cent.)
Gastric ulcer	3	1 (33.3 per cent.)	2 (66.6 per cent.)

These groups are not sufficiently large to base a fixed estimate of the percentage liability of pancreas implication in the diseases mentioned, but they do show a striking frequency of involvement.

The avenues by which infection may reach the pancreas are: (1) The blood stream; (2) through the ducts, and (3) by way of the lymphatics.

The systemic circulation is but little considered in connection with pancreatic disease. The diseased conditions with which pancreatitis is associated are not characterized by bacteræmia, nor is the pancreas often affected in other conditions in which bacteria are commonly present in the blood stream. That this mode of infection may occur is evidenced by the participation of the pancreas in miliary tuberculosis, in syphilis, and occasionally by abscess formation in pyæmia. Still the weight of clinical evidence is against this source of infection of the pancreas in any considerable proportion of cases.

The ducts of the pancreas are commonly regarded as the vulnerable point in the gland's defences. They empty upon a mucous surface which is subject to inflammations and over which pass great numbers of pathogenic bacteria. Ascending infection under these conditions is a ready and seemingly satisfactory explanation of pancreatic inflammation. Furthermore, the usual mode of termination of the duct of Wirsung in the ampulla of Vater affords opportunity for the bile to gain entrance into the pancreatic duct. Gall-stones often travel down the common duct inducing inflammation as they pass and at times diverting the bile into the pancreatic duct in the manner pointed out by Opie. The bile is irritant in itself to the pancreas, and in addition it is frequently infected. Clinical and experimental proof is not lacking that this does occur in life and that it may be productive of the most fulminating hemorrhagic necrosis of the gland. We may infer that the lesser and chronic types of inflammation also may result.

It is not the intention of this paper to deny the importance of this mode of infection, but rather to ask if it has not been overworked as an explanation of the swellings and indurations we are noting so commonly in connection with other abdominal inflammations, particularly in disease of the biliary tract.

The profession at present apparently has resolved the etiology of pancreatitis in connection with biliary disease into the simple picture of infection sailing down the common bile duct and up the duct of Wirsung. The walls of the vessels receive no attention. Yet it is in the walls of the gall-bladder and ducts that the infection chiefly lurks. It is not at all uncommon to find a culture of the bile negative when pronounced infection is evident in the tissues of the gall-bladder and ducts.

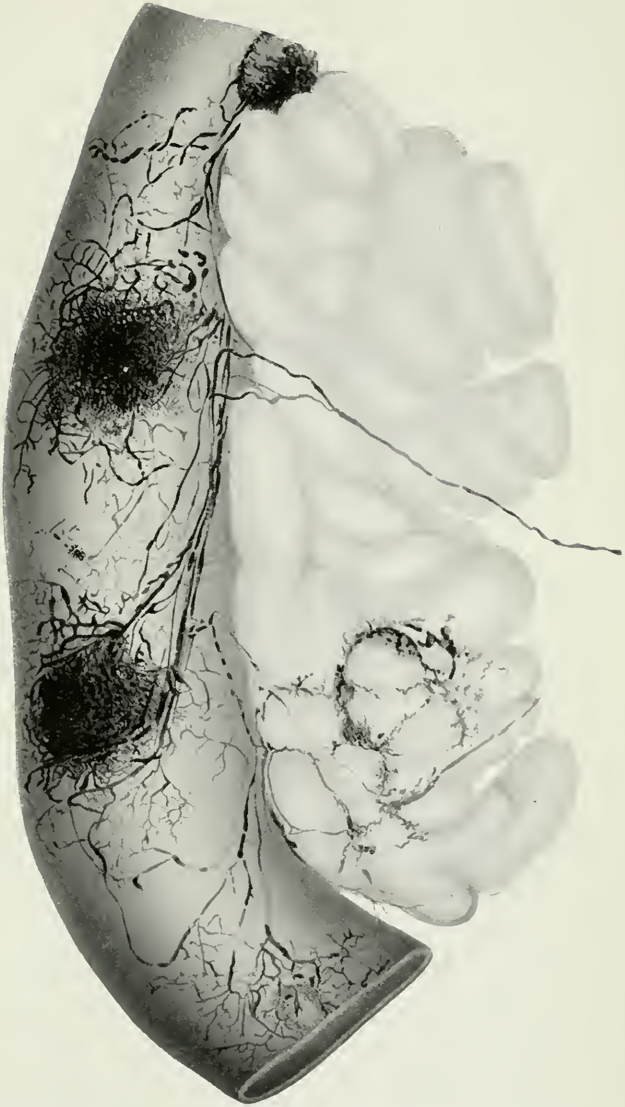
Of the 49 cases, in this series, investigated in the pathological laboratory of the German Hospital, the result of the cultures of the bile is as follows:

Bacillus coli	16
Bacillus typhosus	2
Sterile	24
Not culture	7
	49

In acute infections of the biliary passages the surrounding tissues are greatly inflamed. Any organ in close relationship must be endangered by the proximity.

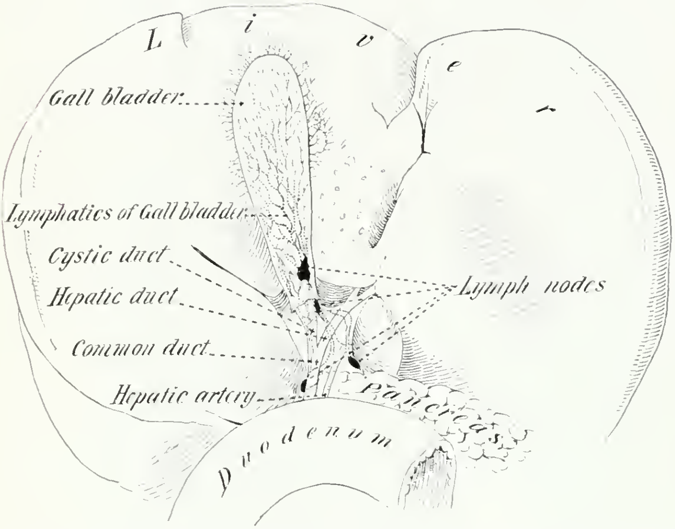
These swellings and enlargements of the pancreas, as noted by the surgeon, certainly differ from those states in which an overgrowth of the interlobular or interacinar fibrous tissue has taken place. There can be no rapid or material retrogression of the process which has progressed to a fibrous sclerosis. On the other hand it is characteristic of many of the swellings of the pancreas, as seen at operation, to subside more or less rapidly

FIG. 1.



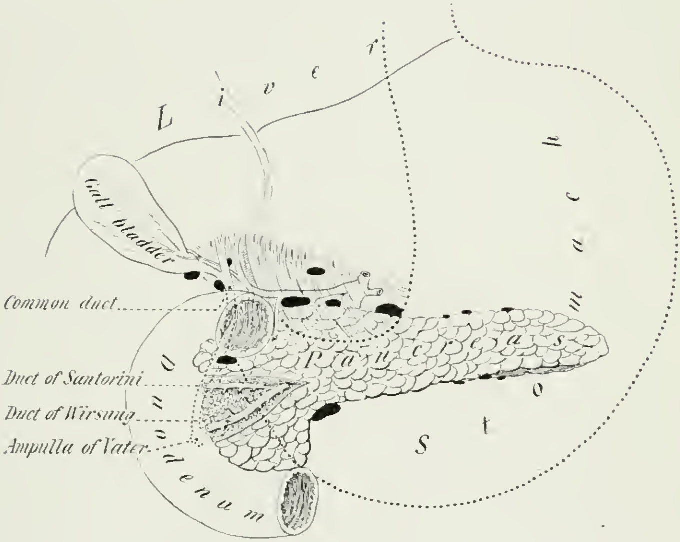
Duodenum and pancreas of newly-born dog, injected to show lymphatics. In many places an intimate connection exists between the pancreatic and duodenal lymph systems. (After Bartels.)

FIG. 2.



Lymphatics of the gall-bladder. The duodenum is turned downward. The lymphatic trunks are represented by dotted lines which may be seen disappearing behind the posterior surface of the pancreas, to the surface of which they are intimately related. (After Franke.)

FIG. 3.



Black areas represent enlarged peripancreatic lymph-nodes commonly encountered in pancreatic lymphangitis.

and completely. This has been determined by secondary operations on patients who showed pancreatic swelling at the first operation, but none when the abdomen was reopened. Clearly the enlargement must have been due to engorgement and œdema or absorbable cellular exudates. It is only by accident that one could have the opportunity to secure for pathological examination a pancreas in this stage. Such an opportunity we have not had. Robson, however, speaks of such a case in which he operated for gall-stones, death occurring from apoplexy during the anæsthesia. A post-mortem examination of the pancreatic tissue surrounding the common duct revealed nothing abnormal to the naked eye, but a careful microscopic examination showed a small celled infiltration between the lobules of the pancreas and swelling of the secretory cells of the gland (*Surg., Gyn. and Obstet.,* January, 1908).

Such minor changes as these in the ordinary length of time which elapses between the death of a patient and the post-mortem examination would be obscured by the rapid autodigestion which the organ undergoes and therefore has been overlooked. The condition has therefore received no attention or name from the pathologists.

A fact which is difficult to explain on the theory that such swellings result from duct borne infection is the usual localization of the lesion in the head of the organ, the tail, as a rule, being unaffected so far as can be determined by palpation. In the cases observed during the past one and a half years the head was affected alone in 42 cases, and in only 9 was the tail of the organ noted as showing any alteration in shape, size, or consistency. In 27 cases there was well-marked lymphadenitis of the glands in the peripancreatic tissue. It is not the rule in other glands, supplied by ducts which divide dichotomously, for ascending inflammation to be limited to the area adjacent to the terminations of the ducts. Thus, in cholangitis the fine radicles at the periphery of the liver show equal involvement with those near the portal fissure. In the pancreas itself the late lesions observed pathologically show sclerosis as marked in the tail as in the body and head. The so-called triangle of pancreatic inflammation lying between the duodenum and the converging ducts of Wirsung and Santorini should not be so commonly affected to the exclusion of the remainder of the pancreas were the infection carried by the ducts, since the remainder of the pancreatic tissue is just as truly supplied by and dependent on these ducts as are the tissues of the triangle. In our opinion a more significant relation is to be found in the proximity of the common duct in its retroduodenal and pancreatic course to this portion of the head of the pancreas.

A path of infection to the head of the pancreas which has received too little attention is that by way of the lymphatics. In the excellent work of Robson and Cammidge on the pancreas, four lines are given to the anatomy of the lymphatics of the gland. In all the extensive literature on pancreatitis it is only rarely that the lymphatics are mentioned. Considering the importance of the lymph channels in both the transmission of infection and in recovery therefrom this neglect is unjustifiable. The pancreas is well supplied with lymph vessels which run in the interlobular septa in company with the blood-vessels and ducts. Unlike the majority of glands, however, the pancreas possesses no great hilum through which emerge the blood and lymph vessels united into trunks of supply. The lymphatics emerge at various points along the course of the gland and make their way through the retroperitoneal cellular tissue to join the thoracic duct. In this retroperitoneal tissue they anastomose with lymph trunks coming from the stomach, duodenum, spleen, liver, gall-bladder, and bile ducts, the colon and even the left suprarenal. Probably still other intercommunications exist which have not yet been demonstrated. Bartels has shown that a particular intimacy exists between the lymphatics from the duodenum and the head of the pancreas.

Through the duodenal lymphatics he has injected vessels which are directly applied to the surface of the pancreas. These vessels inosculate with those coming from the head of the pancreas, and, while he did not succeed in injecting the intrinsic pancreatic lymphatics from the duodenum owing to the competency of the valves, he stated that under pathological conditions the valves would not be likely to prove such an efficient barrier.

Franke has shown that a similar close relationship exists between the lymphatics of the gall-bladder and the head of the pancreas, and Arnsperger has argued the clinical force of such a relationship.

That gall-bladder and duodenal inflammations do cause marked peripancreatic lymphangitis is very easily made out. We have seen scores of such cases since we began to recognize the condition. In a fortunate case the march of the infection is easily demonstrated: inflamed gall-bladder, enlargement of the cystic lymph-glands, periductal lymphangitis, enlargement of the glands at the head and margin of the pancreas and often swelling of the regional lymphatic distribution of the head of the pancreas. In such a case it is not easy to resist the conclusion that the pancreas in this portion had become affected through the lymphatics rather than to assume that the infection had circumnavigated the ducts and localized itself in the pancreatic head.

The irregularly segmental distribution of the lymphatics of the pancreas harmonizes well with the localized areas of infection observed clinically. The lymphatics given off from the common duct in its pancreatic portion in the presence of a marked infection with much periductal swelling and infiltration could hardly fail of being communicated to some extent to the neighboring pancreatic tissue, unprotected as it is by a dense and avascular fibrous capsule.

To the objection that infection, to be carried into the pancreas, must stem the efferent lymph current and force the valves, the answer can be made that everyone has seen infection in cellular tissues proceed in a reverse direction to the lymph-current. Thrombolymphangitis readily diverts the normal lymph course and infection easily destroys valves. The forces of pathology here as in so many other instances pervert the normal function.

The pre-operative recognition of pancreatic lymphangitis in the majority of cases is not yet possible. The greater part of the pancreas remains unaffected and is able to furnish both internal and external secretions to supply all bodily needs. The local signs of inflammation, such as pain and tenderness, are not sufficiently distinctive to be separated from gall-bladder or duct inflammation or from duodenal disease. Occasionally it is possible to palpate the enlarged pancreatic head, but as a rule this cannot be done.

Cammidge's specific reaction "C" has not been of assistance to me. In the laboratory of the German Hospital we have carried out this reaction in upward of 700 cases and have found that it cannot be relied upon as indicating the presence or absence of pancreatic involvement. A Cammidge test was made in 10 of the cases in this series with positive result in 6 instances, negative in 4.

We may infer with fair certainty that the pancreas is affected in the more severe cases of long standing, particularly when the symptoms point to common duct involvement, with tenderness in the median line over the head of the pancreas. But we have failed to find pancreatic swelling in such cases, while in others of very recent origin it has been present.

Under this conception the problem of treating these inflammations resolves itself into the appropriate treatment for the primary infecting focus. The pancreatic and peripancreatic inflammations are analogous to cervical adenitis, secondary to tonsillitis or to inguinal adenitis following upon an infection of the extremity. The subsidence of infection in the gall-bladder, whether brought about by medical or by surgical means, is speedily followed by disappearance of the lymphangitis dependent upon it. In view of the fact that medical treatment, while at times successful, is notoriously slow and prone to fail, and in any case less likely to guard against recurrence it must be regarded as attended by more serious risk of permanent damage to the pancreas.

If the early stages and milder degrees of involvement of the lymphatics of the pancreas may produce but little disturbance and disappear upon subsidence of the primary infecting focus, it is also true that any long continued lymph stasis and infiltrations with damage of the tissue elements must lead to deterioration of the parenchyma and the deposit of fibrous tissue. Swelling of any portion of the pancreas to a greater or less extent causes obstruction of the ducts in that region, so that in this instance also we have the obstructive element added to that of infection.

In the more acute processes suppuration may ensue. Abscesses are most likely to be found in the head of the pancreas. An example of this condition is the following case operated upon in the University Hospital:

Case II.—I. P., female, aged fifty-two years; admitted February 23, 1913.

Chief complaint, severe pain in right side of abdomen, nausea, and vomiting.

Past medical history, had typhoid fever when very small, otherwise no serious illness, but says she has never been strong.

Family and social history have no bearing.

Present Illness.—For the last seven years she has been having "stomach trouble," eructations of gas, heart-burn. Six days before admission she was seized with severe pain in the right upper quadrant of the abdomen, which radiated to the left scapula. Has never vomited blood; has been habitually constipated, and at times noticed the stools were light in color. She never noticed any jaundice prior to this attack.

On admission, temperature, 98.6; pulse, 92; respiration, 20. She was well-nourished and of rather healthy appearance, though somewhat pale. Scleræ showed a slight tinge of jaundice.

Chest: Negative throughout.

Abdomen: Marked tenderness in epigastrium and right hypochondrium, with some rigidity and spasm on palpation. No masses felt.

Blood: Red blood corpuscles, 5,600,000; white blood corpuscles, 16,800; hæmoglobin, 85. Differential: Polymorphonuclear, 92 per cent.; lymphocytes, 5; transitional, 2; eosin, 1.

Gastric analysis: Free HCl, 20; total acidity, 40; occult blood, positive. Fæces showed no bile and were otherwise negative.

Operation (February 28, 1913).—The gall-bladder was found filled with stones. It was acutely inflamed and very friable. The tissues around the common duct were swollen but the duct itself did not appear to be dilated. There was much enlargement of the lymph nodes in the gastrohepatic omentum. The cystic gland was greatly enlarged; the head of the pancreas was swollen to the size of a man's fist with much peripancreatic infiltration; the tail appeared normal to palpation. The stones in the gall-bladder were removed and drainage instituted by a dressed tube. The common duct was opened and explored, no stones were present and the probe passed without difficulty into the duodenum.

The patient's condition was satisfactory after the operation, but during the following week she exhibited a septic temperature with attacks of dyspnœa and palpitation, during one of which she died, March 8, 1913.

Only a partial postmortem was obtainable. The head of the pancreas was greatly swollen and contained several small interstitial abscesses. About the head of the pancreas there was also some suppuration in the peripancreatic tissues. The tail of the organ was slightly enlarged and on section showed a few flakes of fat necrosis.

Microscopic examination showed in the head of the pancreas chronic interlobular and interacinar pancreatitis with acute suppurative process implanted upon it, the tail showed also chronic pancreatitis, but to a much less marked degree. The acute changes also were distinctly less marked in the tail than in the head.

Reasoning from the pathological appearance we can believe that the head of the pancreas had been the seat of many previous attacks of inflammation. This portion of the organ had borne the brunt of the infection transmitted to it from time to time from the diseased gall-bladder. The history of the final attack together with the appearance of the gall-bladder indicated that the origin of the infection in this instance also was the gall-bladder and the lesser lesions, both acute and chronic, which were found in the tail can best be explained as secondary to the changes in the head of the pancreas.

It is not beyond the range of probability that certain cases of hemorrhagic pancreatitis may be initiated by infection reaching the pancreas through the lymph channels. It is certain that not all hemorrhagic pancreatitis is produced by the lodgement of a gall-stone in the papilla of Vater causing retrojection of the bile into the pancreatic duct. A fair percentage of such cases are not accompanied by gall-stones. Neither is it necessary that duodenal contents be regurgitated into the pancreatic duct in order that activation of the retained pancreatic ferments may occur. The hormone secretion arriving by the blood stimulates the secretion of pancreatic juice. Activation of the juice within the gland is not necessary to its digestive action as the clinical observations of fat necrosis and the post-mortem autodigestion of the gland will attest. With infection of the gland, obstruction of the ducts by a resulting engorgement and stimulation of the active pancreatic secretion by hormone action we have all the conditions necessary for focal necrosis of the pancreas, erosion of the blood-vessels, diffused hemorrhage followed by extensive gangrene and suppuration.

If we entertain these ideas of the causation of pancreatitis we must be influenced in our methods of treatment of the lesions of the gall-bladder and the duodenum when pancreatitis is associated.

Theoretically prompt removal of the focus of infection is desirable. Cholecystectomy and excision of ulcer must therefore be viewed from this angle. We have always been opposed to cholecystectomy unless strong indications were present. There is not sufficient time to discuss the pros and cons of this question in which many other factors enter. At this present time, however, we favor the more radical treatment of an obviously thickened and sclerotic gall-bladder when pancreatic lymphangitis is associated with it. In other words we are less disposed to take chances on recurrence of inflammation in the gall-bladder in cases where the fate of the pancreas is also concerned. It must not be forgotten that cholecystectomy is an operation of slightly greater mortality than simple drainage of the gall-bladder and we must therefore strike a proper balance between the immediate and remote dangers. Cholecystostomy in many instances is curative in a surprising manner and must remain the operation of choice in the majority of cases. Cholecystenterostomy should be reserved for those cases in which more or less chronic obstruction of the common duct is a feature.

LARYNGECTOMY FOR CANCER.*

BY GEORGE W. CRILE, M.D.,

OF CLEVELAND, OHIO.

The legitimacy of operation upon any part of the body, especially those parts the damage of which may cause immediate danger to life, depends upon the answers which can be given to three vital questions: Will the operation result in the cure of the disease? Can the risks be overcome? What will be the extent of permanent disability? So uncertain until very recent years have been the answers to these questions as applied to laryngectomy for cancer, that it is not strange that the operation is one of the most recent developments in surgical history, having been first performed by Billroth in 1874.

Even after surgeons had become convinced of the possibility of the cure of intrinsic laryngeal cancer by this means it was, and is still, most difficult to persuade patients to submit to it—the instinctive objection to deep throat operations being the natural outcome of the experiences of the far distant past when the throat was the point of attack in our carnivorous evolutionary ancestors, and it being still the part most liable to danger in hand-to-hand conflict.

Does laryngectomy for cancer result in a cure of the disease? Upon our answer to this depends the need for considering the other two questions. We still accept Krishaber's classification of laryngeal cancer as intrinsic and extrinsic. As the term implies, intrinsic laryngeal cancer starts within the larynx itself in the vocal cords, the ventricular bands or the parts below; while the extrinsic form starts in the epiglottis, the arytenoids or other parts outside the larynx proper. Intrinsic cancer, then, is contained within a hyaline cartilage box and is practically cut off from the possibility of lymphatic involvements; while the extrinsic form grows rapidly and can easily and early extend through the lymph channels.

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* Read before the American Surgical Association, May 7, 1913.

Early diagnosis and removal is the keynote of safety in cancerous growths anywhere, and laryngeal cancer makes itself known almost at once, since from its very beginning the probability of its presence becomes evident in the persistent hoarse voice of the patient. We may say, then, that intrinsic laryngeal cancer exists, as it were, in a safe deposit box. It early announces its presence and has but feeble power of extensive invasion or of metastasis. We conclude, therefore, that this form of cancer of the larynx is curable by excision. Extrinsic cancer, on the other hand, is rapidly fatal, and operation for its relief is at best but a desperate remedy.

What is the surgical risk? I have myself performed twenty-seven laryngectomies for cancer with two operative fatalities; one death resulting from mediastinal abscess, the other from necrosis of the trachea with a consequent septic pneumonia. This makes a mortality rate of 7 plus per cent., a rate which compares favorably with that of the excisions for cancer of the tongue, of the stomach, and of the rectum.

What is the permanent disability of the patient? Those principally feared are impairment of speech, disfigurement, and a predisposition to pulmonary diseases and accidents. As to speech impairment, all patients acquire a buccal whisper which serves the purposes of speech remarkably well. One of my patients is at the head of a large industrial corporation; another is a judge; another is foreman in a public works department; another became a popular barber; still another is managing a small coal sales agency; one housewife apparently gets on well enough; and a farmer has managed his flocks and his teams in silence. The speech defect, to be sure, is great, but it can be compensated to a remarkable degree by the development of the buccal whisper, the use of gestures and other forms of primitive language, and by the adaptation of those individuals who come into daily contact with the patient.

The disfigurement may be well covered by wearing various kinds of cravats or neckwear arranged in such a manner as to allow free breathing, and at the same time to diminish the sibilant sounds of the changing air currents.

As to the predisposition to accident and disease, to my knowledge there has been no instance of a foreign body in the respiratory tract of any of my laryngectomized patients, nor has there been a single case of pneumonia. Not only have my patients shown no tendency to pneumonia and bronchitis, but they have been remarkably free from nasal colds.

We may conclude, then, in answer to our third question, that though the disability resulting from laryngectomy is great, yet it is fairly well compensated.

Some years ago I made an interesting study of the laryngectomies reported in the medical press from 1873 to 1901. A summary of the statistics gives significant results. From 1873 to 1876, 12 laryngectomies for carcinoma were reported with one ultimate cure, making the percentage of ultimate cures 8.33. From 1876 to 1886, 108 laryngectomies, 21 ultimate cures, percentage of ultimate cures 19.44. From 1886 to 1896, 156 laryngectomies, 49 cures, percentage of cures 23.82; from 1896 to 1901, 30 laryngectomies, 20 cures, percentage of cures 66.67. The causes of death as reported are those with which we still are contending, but which improved technic has helped us in large measure to meet. Indeed, the figures just given show the increasing confidence of surgeons and patients in operative relief for this distressing disease, a confidence well supported by the rapidly decreasing mortality rate.

Before proceeding to a description of the general technic of the operation, let us consider how the special difficulties and dangers may be overcome.

1. *Pneumonia.*—Pneumonia following operation on the upper air passages is due in most instances to one of two causes: (*a*) The inhalation of blood, and (*b*) the inhalation of infected wound discharges. These injurious inhalations occur usually in the course of the operation, although occasionally the post-operative oozing is inhaled. They may be

prevented in part by scrupulously maintaining a dry field in the entire course of the dissection. This is accomplished by picking up every vessel that is large enough to be considered at all, either before dividing it or immediately after it has been divided. In this manner the field will be kept so clear of blood that all anatomical structures may be easily seen and identified. During the later stages of the dissection the vessels which have been picked up may be ligated with either light catgut or light silk. While this manner of dissection may at first seem to be tedious, it will in the end prove to be the quickest method, and is the method of choice in dissections for the exposure of the larynx, pharynx, trachea, or œsophagus. When the field of operation has been reached, however, the prevention of blood inhalation becomes a quite different problem, because the blood supply of the mucous membrane is maintained principally by terminal arterioles which cannot be effectively controlled by ligation. At this point in the operation one of two courses may be adopted. The patient may be placed in a head-down, inclined posture at such an angle that the blood will gravitate away from the lung; or by the hypodermic use of novocain and adrenalin the trachea, the larynx, and the pharynx may be entered without resultant coughing or material oozing. If the mucous membrane has been locally anæsthetized the bleeding may usually be controlled by the local application of pledgets of cotton pressed firmly against the bleeding points by hæmostat forceps. The further control of hemorrhage depends upon the circumstances of the individual operation. If conditions permit, a rubber tube which will snugly fill the trachea or even distend it will entirely control the dangerous factor of blood inhalation. This point will be considered later in connection with the administration of the anæsthetic.

There are both advantages and disadvantages to the control of hemorrhage by posture, for the amount of hemorrhage, especially of venous hemorrhage, is increased by gravity. Then, too, the head-down position is less favorable for the operator. The direct control method has the advantage of light, accessible position and the minimum bleeding. In my experience I have rarely found it necessary to resort to the head-down posture, although it has been temporarily used, occasionally during some phase of an operation. Occasionally, of course, a great emergency may exist in which the head-down posture is urgently demanded.

2. *Local Infection.*—The next great danger associated with laryngectomy is that of local infection, for it occasionally happens that after the air passages have been opened a serious local infection will spread over the contiguous territory and along the deep planes of the neck. The occurrence of some infection must be taken for granted, but it is for us to consider by what means the amount and the virulence of the infection may be diminished and how it can be localized. In the first place, the danger may be minimized in advance by canvassing all of the contiguous territories and making sure that there are not present any active foci of infection, such as decayed teeth, pyorrhœa, alveolar abscesses, discharging sinuses, peritonsillar abscess, pharyngitis, or purulent rhinitis. At the time of the operation itself we may control the local severity of the infection by using only sharp dissections and by minimizing to the utmost the trauma of surrounding tissues; by leaving no oozing of blood; by making careful decisions as to the immediate closure of the soft parts overlying the wound, and by using iodoform packing if there must be any wound in the soft parts of the throat and neck. When infection has been inaugurated there are no better therapeutic measures than the hot pack and the inhalation of medicated or plain steam.

3. *Mediastinal Abscess.*—After pneumonia, mediastinitis and mediastinal abscess have been the most fatal after-results of laryngectomy. The onset of infection is usually a week or ten days after the operation, and is characterized by a steeple-chase temperature, not high, and always remitting in the morning. There is usually but little pain, and the course of the disease is toward slow, but certain death. In many respects it resembles the retroperitoneal abscesses which also

come late, are almost painless, progress slowly, show a steeple-chase, but low temperature curve, and end usually in death. The explanation of the characteristic, painless, tedious and fatal course of mediastinal abscess is probably found in the fact that this region of the body has always been protected from wounds by the bony chest wall. Being closed to wounds through the vast periods of man's evolution, it has been closed likewise to infection. The tissue of this protected region, therefore, has not been endowed with the elements required to efficiently meet and overcome infection as have been, for example, the peritoneum and the external parts of the body. In view of this fact, we must guard this helpless territory with special care. How can this be done?

As we have shown that pre-operative measures may in large degree prevent the extensive course of local infection, so the danger of mediastinitis may be guarded against by pre-operative protection. If in the course of the laryngectomy the divided trachea is stitched to the skin, there is great danger that subsequent coughing will cause it to become detached. Its moorings having been lost, it will be thrust back and forth, in and out of the thoracic box, like the piston of an engine. Mediastinal infection will be the almost inevitable result. If, on the other hand, the free end of the trachea is not fixed by sutures, but is held by gauze packing about it, then the trachea will retract within the thoracic cage like the head of a turtle, and again infection must result. It is obvious, then, that the trachea should be so fixed by preliminary operation that there may be produced an invincible barrier of granulations extending across the base of the neck and the entrance to the thoracic cage. There are two methods by which this may be done: The ordinary simple tracheotomy will fix the trachea and will stimulate the formation of efficient granulation tissue; or exposing the trachea and the lower larynx and packing the lateral planes of the neck with iodoform gauze will result in the production of granulations and in fixing the trachea so firmly that coughing cannot break its moorings. Each of these methods by itself alone has certain advantages and disadvantages. The simple tracheotomy is not so certain a safeguard against infection of the mediastinum as is the latter, and it does not result in so firm a fixation of the trachea in the deeper part of the neck; but it has the advantage of establishing a strong defense mechanism in the mucous membrane of the trachea itself. On the other hand, the packing of the deep planes with iodoform, while otherwise an ideal protection, does not supply the protective defenses in the mucous membrane of the trachea. An ideal defense, then, is found in a combination of the two operations, that is, in opening and packing the deep planes of the base of the neck, and at the same seance making a low tracheotomy. By this means the mediastinum is put under strong guard, and at the same time the later technic of the laryngectomy is measurably reduced.

4. *Vagitis.*—Though a less frequent risk than those we have described, vagitis represents a formidable and special danger. In the course of the convalescence following laryngectomy, usually after the fourth day, a group of new symptoms is occasionally introduced; the pulse becomes very rapid and irregular in rate and rhythm—it may jump from 90 to 140 in a few minutes; the heart's action becomes tumultuous at times; the patient is quiet or perhaps a little apprehensive. Death from vagitis has been reported, though in my own cases the symptoms passed after a rather boisterous course of a few days. It is probable that the trunks of the vagi have become involved in the wound infection and as a result these nerves have been rendered unfit to properly conduct stimuli. Hence there arises the striking conflict between the vagus and the accelerator control, the picture being very similar to the immediate effect of crushing or dividing both vagi simultaneously. As a protection against this, one might utilize the well-known physiologic fact that the division of one vagus causes no notable change in the heart's action. In the course of extensive dissections for the wide excision of cancer of the neck I have eight times excised a portion of the trunk of one vagus. Close observation of the pulse and respiration de-

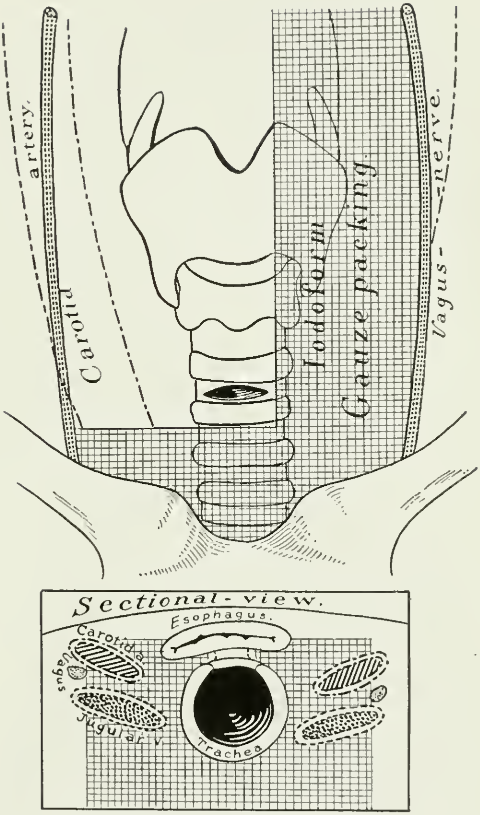
tected no change nor was any later alteration observed. Following this indication, then, at the preliminary operation one should carry the dissection on one side of the larynx all the way to the upper margin of the field of final operation, and should pack this territory with iodoform gauze just as the deep planes of the neck are packed. By this procedure one vagus must take the brunt of exposure and adjustment before the larynx is removed. By the time the laryngectomy is done this vagus would be readjusted and ready to resume its function in case it was affected at all, and so the heavy onslaught of the vagi upon the heart would not be made by both vagi simultaneously. In the case in which I tried this plan it seemed to be completely effective. When vagitis has become established there is little that can be done to alleviate it, although hot applications are apparently of some service.

5. *Reflex Inhibition of the Heart and Respiration through Mechanical Stimulation of the Superior Laryngeal Nerves.*—This is a minor phenomenon peculiar to the surgery of this region, but it is reported to have resulted in several deaths and has caused much anxiety and trouble to those who have never known of its existence and who have not known how to interpret and obviate it. The terminals of the superior laryngeal nerves in the larynx and on the surface of the rima glottidis are of necessity disturbed, and the trunks of these nerves are divided in the course of operation. The function of the laryngeal nerves is the protection of the pulmonary tract from the entrance of foreign bodies. The slightest touch of their endings, therefore, causes a cough reflex, and a strong contact will cause an inhibition of respiration and of the heart. The nerve supply of the trachea has no such function, but the area of distribution of the inhibitory nerve endings extends over a part of the pharynx and a part of the posterior nares even. Fortunately, we have an absolute protection against this dramatic and sometimes dangerous phenomenon, in the hypodermic administration of $\frac{1}{100}$ grain atropin (adult dose) before the operation. In addition a spray, a local application, or the local hypodermic injection of novocain will control absolutely the inhibitory reflexes.

6. The last special difficulty which we shall consider relates to the after care of the patient, and refers to the selection and care of the tracheal canula. After trying many kinds of canula, I have found that the common male or female curved canula or plain rubber tubing even, will answer all purposes. The greatest care should be exercised in adjusting the metal tubes so as to prevent a decubitus on the posterior wall of the trachea. Rubber tubing is preferred by some patients, but the metal tubes usually are best. A rubber tube drawn over a metal tube is perhaps the easiest to wear, but I have found that patients become careless with their familiarity with danger, and will wear loose-fitting tubes. This point was strongly impressed on my mind by the difficulty I once encountered in extracting a rubber tube that had slipped off the metal tube and had been carried deep into the trachea. After a stormy session in which the patient almost suffocated, the tube was caught by groping deep within the trachea with a curved hæmostat forceps and it was extracted while the patient was unconscious from asphyxia. In time all laryngectomy cases get along without tubes. In fact, in my recent cases I have been able to dispense altogether with tracheal tubes, both at the time of the operation and ever afterward, and my patients have all preferred to get along without phonating apparatus.

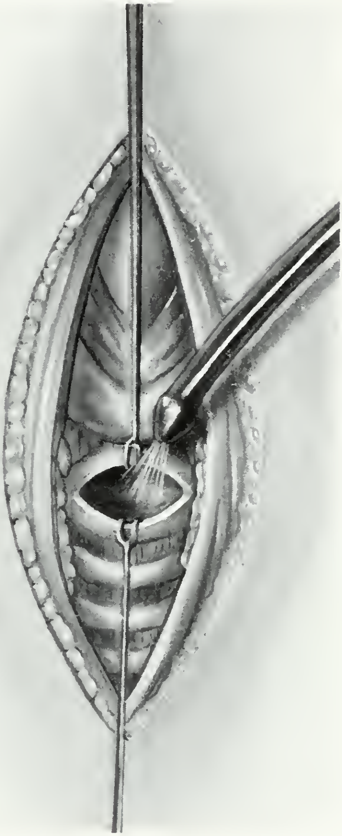
Anæsthetic.—Before proceeding to the detailed technic of the operation itself, some special statement should be made regarding the manner of administering the anæsthetic. It should be borne in mind that the administration of the anæsthetic should be so planned that the operator may be unhampered in his technic, that the anæsthetist may give an even and safe anæsthetic, and that there may be no inhalation of blood, while the choice of the anæsthetic itself is a most important factor. Our general anæsthetic of choice is nitrous oxide. The patient already—it is to be presumed—in fear of the possible suffocating results of a laryngeal operation, takes this anæsthetic without the terrifying suffocating symptoms caused by ether, and is quickly under its influence without a struggle.

FIG. I.



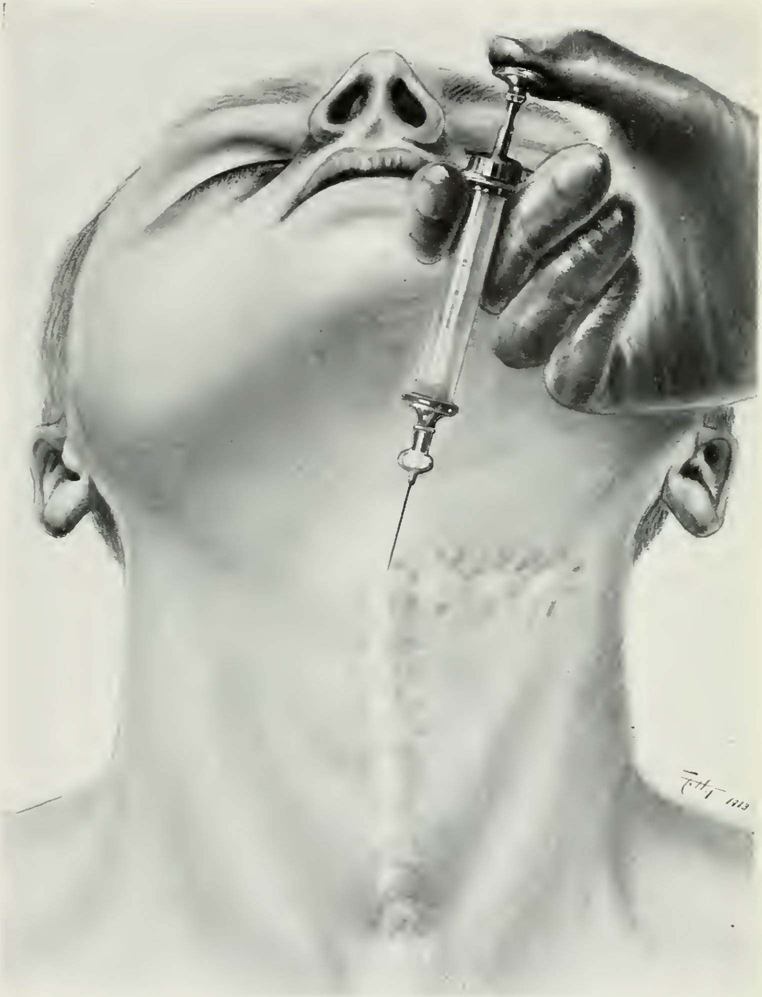
Schematic drawing to illustrate the method of packing the lateral planes of neck with iodoform gauze at preliminary operation.

Fig. 2.



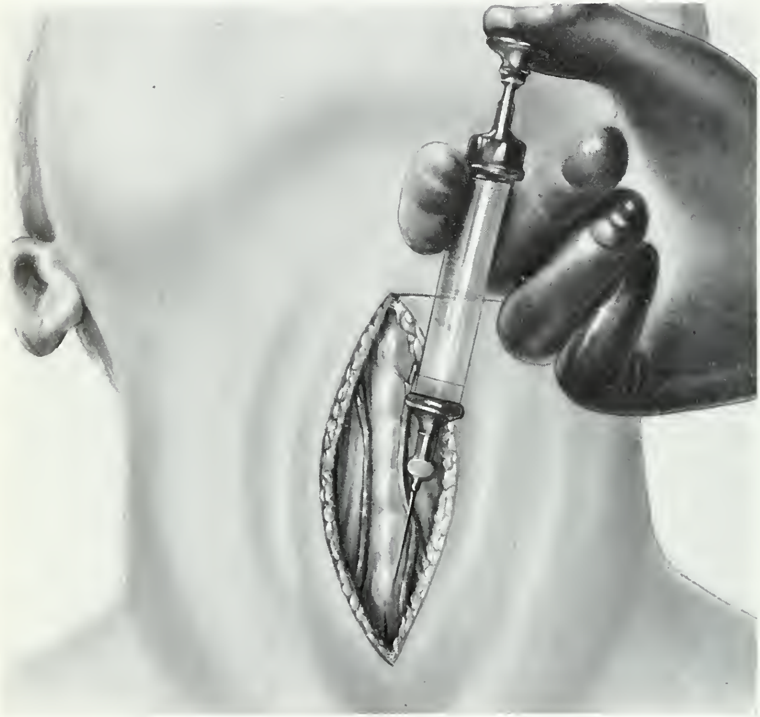
Novocainizing the superior laryngeal nerve endings of the trachea.

Fig. 3.



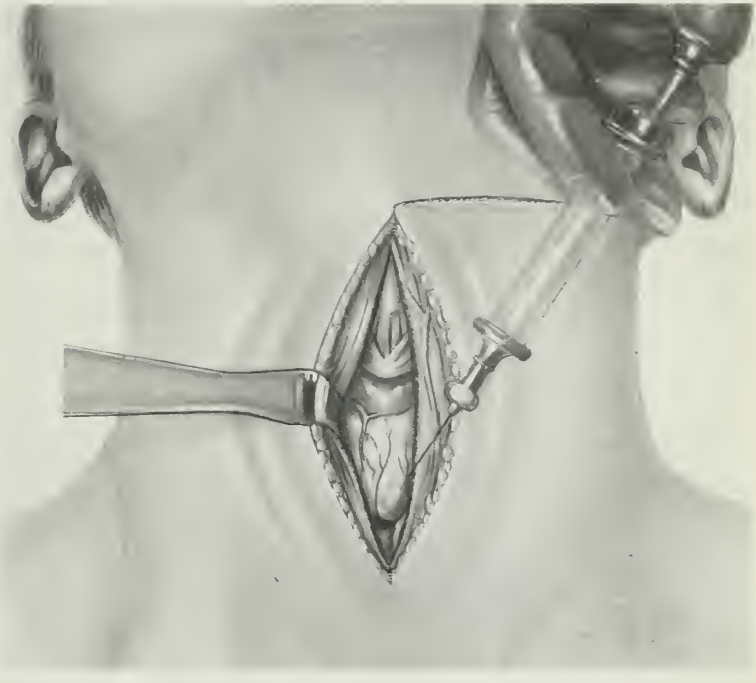
Infiltration of skin with novocain.

Fig. 4.



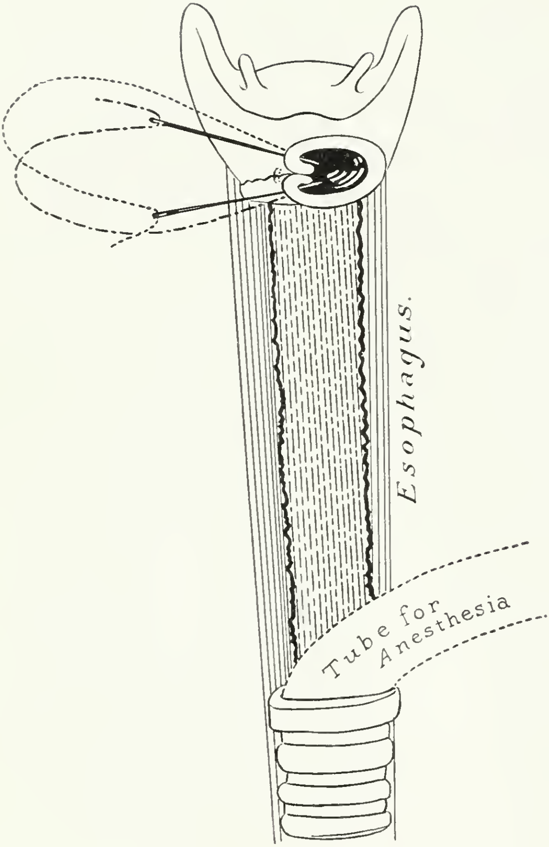
Infiltration of fascia with novocain.

Fig. 5.



Infiltration of the deep tissues of the neck with novocain.

Fig. 6.



Shoemaker's stitch used in closing pharyngeal opening.

We have proved also by laboratory experimentations that nitrous oxide hinders the general impairment of the patient, whereas ether is often an adjuvant to such impairment. Since nitrous oxide, however, should be given by the trained anæsthetist only, the following technic is equally applicable to the administration of ether. We have described already the preliminary tracheotomy by means of which the trachea has become firmly fixed in its position. At the time of operation the tracheotomy tube is removed and a well-lubricated, snug-fitting rubber tubing a foot or more long is slowly and carefully slipped into the trachea. The rubber tubing being slightly larger than the trachea, the latter is dilated and the rubber tube compressed, so that a fluid-tight fit results. By this means the entrance of any blood into the respiratory tract is prevented. The long piece of rubber tubing may then be attached to the oxygen apparatus, or it may be joined to a special apparatus consisting of a funnel covered with gauze upon which ether may be dropped. By this arrangement the anæsthetist is at a distance from the field of operation and is unhampered by the operator, while the operator on his side is unhampered by the anæsthetist. There results an even anæsthesia and the best opportunity for a well controlled operation.

To prevent nocuous impulses from the field of operation from reaching the brain, and as a protection against the excitation of special reflexes through the mechanical stimulation of the trunk or terminals of the superior laryngeal nerves, novocain is used as a local anæsthetic. The manner of its administration will be given in the description of the technic of the operation.

Operative Technic.—First the skin is thoroughly infiltrated with novocain along the median line from a point above the hyoid bone to the tracheotomy opening. The tissues are divided down to the box of the larynx, the divisions of the platysma and of the other soft parts being preceded also by novocain infiltration. The dissection is then carried down along the lateral aspects of the larynx until the larynx is completely freed. If there is lack of free working space at the upper end a lateral incision is made parallel with the hyoid. The thyrohyoid muscles above and the sternothyroid muscles below are severed. So far as its muscular attachments are concerned, the larynx is now completely mobilized. If the laryngoscopic examination has fixed accurately the limits of the neoplasm, the level of the division of the larynx may be predetermined, and the next step will be the division of the trachea or the cricoid at a level free from disease. Before this last division is made, however, novocain is infiltrated into the mucosa throughout the entire length of the proposed division. By this means the terminals of the superior laryngeal nerves are completely blocked and the mucosa may be divided and the larynx opened without causing a change in the respiration or the circulation. If the patient is old and the cartilage is ossified, it is necessary to exert the greatest precaution in dividing the larynx in order that the œsophagus may not be injured. The divided end of the larynx is next raised up and the attachment between the larynx and the œsophagus is divided with knife or scissors. In a short, thick neck the wings of the larynx which extend down laterally to protect each side of the œsophagus, are divided with scissors. The dissection is then carried upward until the upper end of the larynx is reached, where its posterior wall becomes fused with the anterior wall of the pharynx. The upper end of the larynx is then cut free, the larger arteries being severed at the very last. Hæmostasis must be most thoroughly observed throughout the operation. If the cancer is intrinsic the lymphatic glands which drain the diseased zone should be carefully removed with the larynx itself.

Two important questions now arise regarding the manner of dealing with the wound: (1) What shall be done with the end of the trachea, and (2) shall the entire wound of the neck be closed? As to the trachea, there are two alternatives, viz.: It may be freed sufficiently to bring it forward and stitch it to the skin, or it may be left where it lies, excepting at its very upper end, which may be bent forward and sewed to flaps of skin brought down from each side. The advantage of the first method is that by this means the trachea is protected from the inhalation of wound secretion. The disadvantage is the very definite possibility that the loss of blood supply may result in gangrene of the trachea. This did occur in one of my cases. The objection to leaving the trachea in its natural bed and transplanting to it the skin flaps is the fact that wound secretion will almost certainly enter it. By giving the wound adequate care, however, this danger may be avoided.

As to the care of the rest of the wound, my best procedure has been to suture the opening in the pharynx and, if possible, to re-enforce this suture by drawing other soft parts together over it. The rest of the field is left open, being packed lightly with iodoform gauze. With such a wide open wound the secretions may be easily controlled and prevented from entering the trachea. The patient should be sustained by the fullest diet he can be made to take, and by most careful nursing. The sutures in the pharynx may not hold, but the formidable-looking wound will close very readily by granulation and contraction.

Laryngectomy is followed usually by a brisk local reaction; but since the mediastinum has been protected by the previous gauze packing, and the bronchopulmonary tract has been given a special defense by the preliminary tracheotomy, the patient is well equipped to meet the new condition.

Clinical Observations.—In my twenty-seven laryngectomies there were two deaths, and these two were apparently the most promising cases of all. The prognosis in these cases seemed so favorable that I ventured to discard the full preliminary preparations. In one case I made no preliminary protective operation of any kind, and the patient died at the end of five weeks with mediastinal abscess. In the other case I made a preliminary gauze packing in the neck around the trachea, but did not perform a preliminary tracheotomy. In this case I brought the isolated upper end of the trachea forward to the skin and anchored it. The entire isolated portion necrosed, as did also a portion of the trachea beyond the isolated part. As a result pus was inhaled into the respiratory tract below the level of the sternum. An autopsy showed no pneumonia and no mediastinitis, but a septic tracheitis and bronchitis. Death was the result of local absorption, and of absorption from the trachea and from the bronchial mucosa. This case demonstrated most conclusively the efficiency of the granulation barrier which is created by a preliminary iodoform packing. Had I made a preliminary tracheotomy, or had I allowed the trachea to remain in its bed, the patient would surely have recovered.

In 16 of these 27 laryngectomies for cancer the laryngeal box was so choked with the growth that tracheotomy was required to prevent suffocation. Most of my patients gave a long history of hoarseness followed by gradual, though intermittent, obstruction to respiration. In two cases there was associated lues. One of these last two cases illustrates well the clinical difficulty of diagnosis. The lesion was first diagnosed correctly as luetic, and under a course of treatment the greater part of the growth disappeared. The residual growth, however, showed a progressive tendency, and was later diagnosed as cancer. Laryngectomy was performed and the patient is now alive and well, more than three years since his operation. The special lesson from this case is that cancer of the larynx, like cancer of the tongue, may follow local luetic lesions. There is danger, therefore, that the hope of a luetic cure may defer too long the laryngectomy which is the only chance for the cure of the cancer.

As the lymphatics are involved in extrinsic cancer, a much wider dissection is required. As already stated, operation in cases of extrinsic cancer is but a palliative remedy, but even in such cases total laryngectomy is advised, because local recurrence comes more surely and more quickly if one cuts into the growth.

Summary.

Surgical experience has demonstrated that intrinsic cancer cannot invade hyaline cartilage; that it tardily, if at all, metastasizes; that it frequently follows in the wake of benign tumors and of syphilitic ulceration; that the immediate mortality is now well controlled; that the disability and deformity of the laryngectomized patient should have no weight in deciding for or against the operation; that special training and experience are required to thoroughly master the technic; and that if recognized early, and removed completely, intrinsic laryngeal cancer is perhaps the most curable cancer of the body. In view of the results obtained, there is no longer any justification for the pessimism which still disheartens the victim of laryngeal cancer and prevents him from utilizing his one chance of life.

I. THE EXCISION OF BOTH LOBES OF THE THYROID GLAND FOR THE CURE OF GRAVES'S DISEASE. II. THE PRELIMINARY LIGATION OF THE THYROID ARTERIES AND OF THE INFERIOR IN PREFERENCE TO THE SUPERIOR ARTERY.*

BY WILLIAM S. HALSTED, M.D.,
OF BALTIMORE, MARYLAND.

I. In 39 cases of Graves's disease for the cure of the hyperthyroidism it has been necessary to excise, at two or more operations, the greater portion of both lobes of the thyroid gland. Several of these patients, operated upon as long ago as 1902 and 1903, are still under observation and in quite perfect health.

In all of these cases the second lobe was removed because excision of the first had been followed by insufficient improvement. In several instances in which the ligation of three arteries plus the excision of one lobe had been attended with almost negative results, relief from all symptoms followed immediately upon the removal of the remaining lobe; hence the advisability, repeatedly emphasized by Dr. Halsted in his publications, of operating upon the first lobe in such manner that the second may be excised without danger of tetany. A small slice of each thyroid lobe is left in order to protect the circulation of the parathyroid glandules. The operation is performed in an absolutely bloodless manner, all of the blood-vessels supplying the lobe being clamped (but not ligated until after the lobe has been cut away) at a safe distance from the parathyroids.

No muscles are divided in the course of the operation except a few of the fibres (usually the posterior fibres) of the sternothyroid. Hæmostasis is attended to with scrupulous care and the wounds are closed without drainage. There has been no death in this group from operation although, in general, it includes the most serious cases, so serious that, in the majority of them, preliminary ligation of one or more arteries was done. In one case the four arteries were tied, at as many operations, before the lobectomy was hazarded.

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* Read before the American Surgical Association, May 7, 1913.

Kocher having emphasized the importance of lymphocytosis in hyperthyroidism, a differential leucocyte count has been made. Almost invariably the proportion of lymphocytes was increased, once being as high as 65 per cent. But in one case, the most serious of all, the total percentage of lymphocytes was only 9. It has particularly interested Dr. Halsted to observe that there has been a gradual reduction, after operation, of the lymphocytosis in these cases.

The role of the thymus in Graves's disease is probably of great importance. With the advances in skiagraphy it has become possible to detect enlargement of the thymus too slight to be determined by percussion. It seems probable that in a very considerable large percentage (75 per cent. or more) of the pronounced cases the thymus is enlarged.

The hyperplastic thymus may be in great measure responsible for the disproportionate number of the mononuclear leucocytes. In one of the cases, a boy, aged sixteen years, with only mild hyperthyroidism, the lymphocyte percentage was 56, and there was enlargement of the thymus so great that Dr. Halsted could easily remove a part of it from the ordinary collar incision of Kocher.

In none of the cured cases which returned for observation during the past winter was evidence of persistence of the thymus found skiagraphically, and in none of these was the percentage of lymphocytes above 33.

The tendency, after removal of one lobe, is toward lessening the hyperplasia in the other. This tendency is probably greatest in the cases which improve most. In these, unfortunately, we have no opportunity to see the other lobe, for there is no indication to excise it.

When the second lobe is removed it is always because patients are not sufficiently benefited by the removal of the first lobe.

In some the second operation is done promptly (two to four weeks after the first) and in these the interval is so short and the improvement from the first operation so slight that great change in the histological picture is not to be expected.

And when the interval has been long the second operation may have been delayed by the patient until she is in worse condition than originally, and the hyperplasia has become correspondingly advanced.

Sometimes the second lobe has been removed several years after the first and when the patient was still vastly better than before the first lobectomy. In these patients the improvement in the histological picture may be considerable.

II. It happens that in no instance have we found that the preliminary ligation of two, three or even of the four arteries sufficed to cure the patient seriously ill with Graves's disease, although we have observed that considerable improvement, for a short time at least, may follow the ligation of even a single artery. Ligation in our clinic has been practised only in the most serious cases and always with a view to improving the patient's condition to such an extent that lobectomy might safely be performed and to testing her resistance to operation, hence I have endeavored to reduce the preliminary procedure to the simplest possible terms, ligating each artery through a space just large enough to admit of exposure of the vessel—a space too small, as a rule, to admit more than one finger. For the past two years or more I have tied the inferior in preference to the superior arteries and for the following reasons:

1. The cosmetic effect is better. The incisions for ligation of the superior vessels have to be made at a higher level than the Kocher collar incision, which is invariably employed for the lobectomy, and there results, in consequence, a well-like band of skin between the two horizontal cuts which is a pronounced disfigurement.

In tying the inferior vessels the incisions correspond, as I have said, precisely to the line of the lobectomy wound of the skin; and in the making of the latter the fine scars of the former are excised.

2. The wounds made for ligation of the inferior arteries are partly outside of the field of the lobectomy operations, whereas, when the superior arteries have been ligated, a considerable part of the operation for removal of a lobe is through freshly healed, matted tissues whose resistance to infection is lowered. Although suppuration is not very likely to take place even when two or three operations are performed at short intervals through the same tissues, the reaction is greater and breaking down of the wound quite possible.

3. As the inferior thyroid artery is usually larger than the superior, the effect of the ligation may be greater.

4. The superior artery, or arteries, are regularly tied in the course of lobectomy; hence when both inferior arteries have been tied and a double lobectomy is performed all four of the thyroid arteries will have been occluded. On the other hand, if the superior arteries had been ligated at the preliminary operation, the portions of both lobes remaining after a double lobectomy would receive a fuller blood supply.

5. The location of the inferior artery is less variable than that of the superior vessel, which is subject to great changes because of the inconstant position of the superior pole.

The ligation of all the structures of both superior poles through an incision which stretches across the neck—a procedure which has considerable vogue—does not seem quite rational to me for the reason that the results would not be likely to be adequately proportionate to the magnitude of the operation. The ligation of all four of the arteries through small incisions such as I have described, would hardly be more formidable than the operation just referred to and the benefits would, I believe, be greater.

The danger of tetany from the occlusion of the four arteries is probably not so great as I formerly supposed, provided that the ligations are done neatly and at safe distance from the parathyroid glandules. Ligation of the four arteries in close proximity to the parathyroids and through large incisions might result quite differently. In three instances, in which I have ligated the four arteries in two or more acts and subsequently removed the greater part of both lobes in the manner about to be described, transient symptoms of tetany manifested themselves.

The inferior thyroid artery is ligated as follows: A transverse cut, from 4 to 4.5 cm. in length, is made over the tendon of the omohyoid muscle precisely in the line of the Kocher collar incision as contemplated for the subsequent lobectomy. The fibres of the sternomastoid muscle are separated in line of the common carotid artery at the level of the omohyoid tendon. The thyroid lobe is exposed behind the posterior fibres of the sternothyroid muscle and drawn inward by a retractor designed for this purpose. The common carotid is retracted outward by a similar though somewhat shorter instrument and the layers of fascia covering the inferior thyroid artery are divided at the level of the omohyoid tendon. The dissection is then carried out solely with the two long, delicate, blunt dissectors, for the artery is sometimes at a great depth (greatest when the Graves's disease has been engrafted on a colloid goitre), and the space is only large enough, as a rule, to admit one finger between the deeply concave retractors. A special aneurism needle is used for carrying the fine silk ligatures around the artery. The wound is, of course, not drained. The operation, if performed precisely in this manner, is not difficult. Only once have we failed to find the artery in its usual situation; this was about five years ago.

PARTIAL OCCLUSION OF THE THORACIC AND ABDOMINAL AORTAS BY BANDS OF FRESH AORTA AND OF FASCIA LATA.*

BY WILLIAM S. HALSTED, M.D.,

OF BALTIMORE, MARYLAND.

LIGATION of the human abdominal aorta has been made nineteen or twenty times and always with fatal result.

Dubois, Assalini, Bujalsky, Cooper, Keen and perhaps others attempted to occlude the abdominal aorta gradually by means of cleverly devised instruments which, carrying snares of silk, metal or catgut, might be tightened or loosened at will. The instruments traversed the abdominal wall and hence infection was a complication common to all of the methods and defeated the plans of the operators.

In 1904, assisted by Dr. W. F. Sowers, I began a series of experiments on dogs in the hope of finding a safe method of occluding the aorta and curing aortic aneurism. Bands of silver and aluminum curled about the aorta by an instrument constructed for this purpose were rolled tighter by the fingers until the desired degree of occlusion of this vessel was obtained. The abdominal wounds were closed with the expectation that they would have to be reopened one or more times for the purpose of progressively occluding the lumen of the artery. But in the course of our experiments we had opportunities to make trial in the human subject of partially occluding bands on other arteries (innominate, subclavian, carotid, femoral, popliteal) whose blood streams in some instances it seemed unsafe to cut off suddenly and completely, and found that occlusion of an artery, carried to the point of obliterating the pulse, usually sufficed to cure the aneurism, possibly quite as surely as might have been expected of total occlusion. Hence, tentatively, I abandoned the idea of progressive closure of the aorta determining, instead, to obliterate the lumen of this vessel, in the attempt to cure its aneurism, to an extent which we had found quite safe in the dog.

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* Read before the American Surgical Association, May 7, 1913.

I have applied an aluminum band to the human aorta four times; twice in one subject and twice with promising results so far as the cure of the aneurism is concerned. But the experimental work on animals had led me to expect that ultimately the metal bands must cut through the artery because in cases observed for seven months or less the wall of the aorta had become atrophied to the thinness of paper and there was no adhesion between the infolded, attenuated surfaces. That my fears were well founded was proved by an experience in Europe, about eighteen months ago. The patient was an aged woman with dilated and badly functioning heart. The large aortic aneurism was well located for the placing of a band which was applied just below the renal vessels. Within a few days the aneurism, which before operation was distinctly visible from the seats of the operating amphitheatre, was barely discernible at the bedside, and at the end of six weeks had disappeared so completely that the patient was discharged apparently cured. But, walking out of the door of the hospital she was seized with a pain and returned to her bed. The following morning she died from hemorrhage. The aorta had ruptured at the site of the band, but the aneurism was found to be nearly cured.

Stimulated by the result in this case to further experimentation it occurred to me to test the behavior of cuffs and spiral strips of the fresh aorta of one dog when wound about the aorta of another. So on April 29, 1912, I operated upon two dogs, partially occluding the aorta of one of them with a spiral aortic band and of the other with a cuff cut from the same vessel. Strips of aorta were employed rather than of fascia lata, for example, because I hoped that the elastic tissue, in case it did not endure might, at least, serve its purpose for a time sufficient to cure an aneurism.

At the end of two months one of the dogs was killed and

I was pleased to find that the cuff which had been used in this experiment was apparently organized and had not stretched to any appreciable extent. Above the cuff the aortic pulse was forcible, but below the constriction it was very feeble, though countable and accompanied by a thrill.

The other dog operated upon at the same time and in the same manner, except that a spiral band of aorta instead of a cuff had been employed, died (cause of death unascertained) about three weeks after the operation. In this instance the aorta had been almost completely occluded by the spiral aortic strip. The welt-like band had not stretched and seemed to be organized. The aorta, on being split longitudinally, was seen to be greatly wrinkled and almost occluded at the site of the band. Sections of the specimens indicated that the elastic coats of the bands as well as of the included artery were intact.[1] During the present winter I have made about twenty-five similar experiments with encouraging results. We have learned, however, that whereas the spiral bands seem to be perfectly safe there is danger in the employment of the cuffs. In two instances of twelve or more experiments, one of the mattress sutures taken to hold the flaps of the cuffs together cut part way through the cuffs and thus, being brought in contact with the aortic wall, wore a minute hole in the vessel through which the animal bled to death. Such an accident can hardly happen with the employment of the spiral strip, for not only is the strain on the stitches very slight when this form of band is used, but even if it were so great that a thread might cut through the spiral at any point, it could hardly be brought to bear upon the aorta in such way as to wear into its wall.

To each end of the band of fresh tissue a narrow tape is sewed to facilitate the manipulation of the transplant, which is wound twice about the aorta. When one or two stitches have been taken at one end to hold the contiguous edges of the spiral together at this point, the other end of the strip is pulled upon until the aorta is occluded to a little more than the desired amount, and then two additional stitches are taken to maintain the constriction.

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[1] These observations were briefly reported a year ago in a footnote to an article entitled "The Effect of Ligation of the Common Iliac Artery on the Circulation and Function of the Lower Extremity." The *Johns Hopkins Hospital Bulletin*, July, 1912, p. 217.

Within the past few weeks I have examined the bands of aorta, fascia lata and chromicized submucosa which had been wound about the aorta last autumn and winter. In two instances in which considerable constriction of the aorta had been made about four months previously, kymographic tracings of the blood pressure in the femoral and carotid arteries were made in the physiological laboratory by Professor Howell and Mr. Cecil. To our surprise there was no diminution in the femoral pressure, and on investigating the band it was found in each instance to have relaxed and to have been partially absorbed.

In dogs operated upon as long as seven months ago there was considerable absorption of the band; and in one instance only a trace of it remained. One spiral band which had been applied so as to make almost total occlusion seven months before seemed microscopically to be well preserved, but it no longer constricted the aorta, the lumen of which was completely restored, and whose underlying wall was apparently normal.

These findings do not discourage me, for if the constriction can be maintained for two months or even one month, it might effect the cure of an aneurism, and if not, a totally occluding ligature might perhaps, after such lapse of time, be applied without great risk, and possibly the aneurism in some cases might then be excised. The desirability of transplanting, when feasible, a segment of vessel must always be borne in mind.

About three weeks ago I received from Dr. Francesco Nassetti a reprint of a paper by him entitled " Avvolgimento di vasi Sanguigni con lembi liberi di aponeurosi," and published April 26, 1912, in the *Atti della R. Academia dei Fisiocritici in Siena*. Dr. Nassetti's experiments were made in the

Instituto di Pathalogia Speciale Chirurgica della R. Università di Siena, which is under the direction of Prof. A. Salomoni. His first experiment (a band of fascia about the carotid artery) antedates mine by fifty-six days, and his article appeared about three months before the publication by me of a brief account of my first experiments with spiral strips of aorta (*Johns Hopkins Hospital Bulletin,* July, 1912, p. 217). Dr. Nassetti has written on the cover of the reprint which he kindly sent me that his article appeared in print April 26, 1912. My first experiment with the bands of fresh aortic wall was made April 29, 1912, three days after the publication of Nassetti's report. Hence the credit for the idea of constricting blood-vessels with bands of fresh tissue belongs, I am happy to say, to Italy, the country of the famous surgeon, Luigi Porta, who was, I think, the first to attempt the partial occlusion of an artery. I have the impression that Porta used for this purpose a strip of diachylon plaster.

THE SURGERY OF THE PULMONARY ARTERY.*

BY WILLY MEYER, M.D.,

OF NEW YORK.

Attending Surgeon to the German and Post-Graduate Hospitals.

ANATOMY.

The trunk of the pulmonary artery is easily accessible: On longitudinal incision of the pericardium to the outside of the plexus made up of the left phrenic nerve and vessels which run right on the surface of the sac, the first vessel encountered is the pulmonary artery. Its direction is obliquely upward and backward toward the left. The forefinger or a large curved sound introduced right below it in a backward and upward direction toward the right of the patient, enters the transverse sinus of the pericardium (see Fig. 1) and passes around the artery and the ascending aorta which latter lies on the right side of the pulmonary artery. Both vessels are intimately connected by means of connective tissue and are surrounded by the same layer of the visceral pericardium; it is impossible to separate them. There is no defined sheath of the pulmonary vessel, a thin layer of subserous fat presents itself after the pericardium has been opened. The main trunk of the pulmonary artery lies almost entirely within the pericardium and is about five centimetres (two inches) long. At the concave border of the aortic arch the vessel divides into the right and left branches. The right, longer than the left, turns downward and backward around the ascending aorta, passes the superior vena cava, and divides into two branches, an upper and a lower one (Fig. 1), at a level with and right above the right bronchus, before it enters the hilus of the lung. Further on, these two again divide, the pulmonary artery branch always running "to the north" of the respective bronchus. This is an important anatomical point. The left (shorter) main branch of the pulmonary artery first continues in the original direction of the parent trunk, but soon turns downward in front of the left bronchus and the descending aorta toward the hilus of the left lung. There are many varieties in the subdivision of the pulmonary vessels.[1]

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* Read before the American Surgical Association, May 7, 1913.

OPERATIONS.

I. *Removal of Pulmonary Emboli. Trendelenburg.*

In man the best method known at present of obtaining access to the main trunk of the vessel is that devised by Trendelenburg. In experimental surgery upon dogs, an intercostal incision in the third or fourth space with use of rib-spreader suffices for proper access.

Trendelenburg's operation, as finally worked out, is briefly as follows: A horizontal incision about ten centimetres long is made upon the left second rib, beginning at the left border of the sternum and dividing skin, fascia and fibres of the pectoralis major muscle. This is crossed by a perpendicular cut which starts right below the sternoclavicular articulation and passes the cartilage of the third rib about one inch outside of the sternal border; it avoids the left internal mammary artery (Fig. 2, *a*). The two triangular flaps with underlying muscle are turned back (Fig. 3), isolation and division of the second rib outwardly. In raising and twisting its sternal portion the cartilage breaks; this portion of the rib is removed; division of the third cartilage in a perpendicular line. Usually by this time the pleura has been opened and the use of differential pressure is welcome, provided time and a sufficient number of assistants are at the surgeon's disposal. If the pleura had not been opened a ⊢ incision through it, corresponding to the outer one, has to be made (see Fig. 3). The lung is allowed to collapse somewhat and thereby the pericardium exposed. Upon it the phrenic nerve with phrenic vessels become visible. Inwardly of the same the pericardium is incised at the level of the third rib and the wound lengthened in an upward and backward direction until the entire upper half of the pericardium is divided; the lower half remains closed and the heart itself in its normal position. All this can be well done within five minutes. A rubber tube with the help of Trendelenburg's sound (Figs. 3 and 4, *a*) is then quickly drawn through the transverse sinus of the pericardium around the ascending aorta and pulmonary artery, held, and pulled upon for compression by an assistant, immediately before the surgeon punctures the vessel with a sharp-pointed bistoury. The presenting thin layer of fat with the visceral pericardium having been torn, if time permits, with care between two anatomical forceps, the wound in the arterial wall is lengthened for about one centimetre (½ inch). Without a moment's loss of time a specially curved, blunt forceps (Fig. 4, *b*) is introduced, first into the main artery, then into its branches, the thrombus or thrombi grasped and extracted (Fig. 5). Only 45 seconds are at the disposal of the surgeon for this, the principal part of the operation, since observations have shown that the interruption of the circulation in this part of the body is not tolerated longer. Now the lips of the vessel wound are lifted up by special forceps (Figs. 4, *c* and 6 *a*), and temporarily closed by a clamp (Figs. 4, *d* and 6), after which the assistant interrupts the elastic compression. Circulation therewith having been re-established, the heart immediately begins to work, often violently, if the patient had not died before. If needs be, the manœuvre of compression, reopening of the arterial wound and introduction of forceps can be repeated. Closure of the wound in the pulmonary artery by interrupted silk sutures is rendered easier by pulling at intervals on the elastic tube, which will put the artery at rest for a few seconds. Closure of the wound of the pericardium and chest wound according to ordinary surgical rules.

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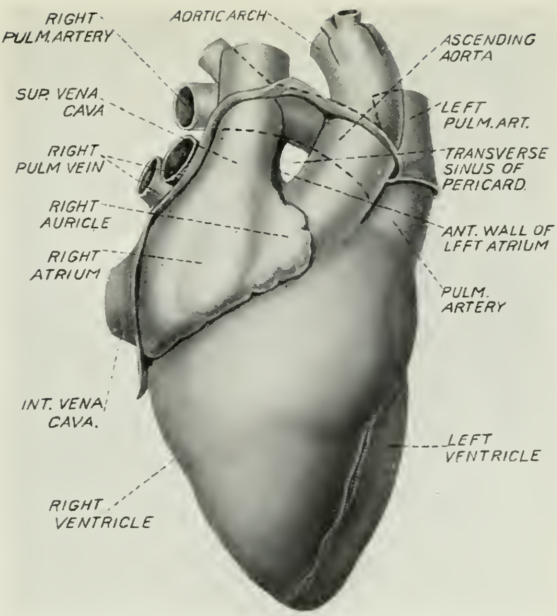
[1] Cf. E. D. Schumacher: Verhandl. d. Deutschen Gesellschaft fuer Chirurgie, 1911, pg. 246; and v. Langenbeck's Archiv., vol. 95, pg. 536.

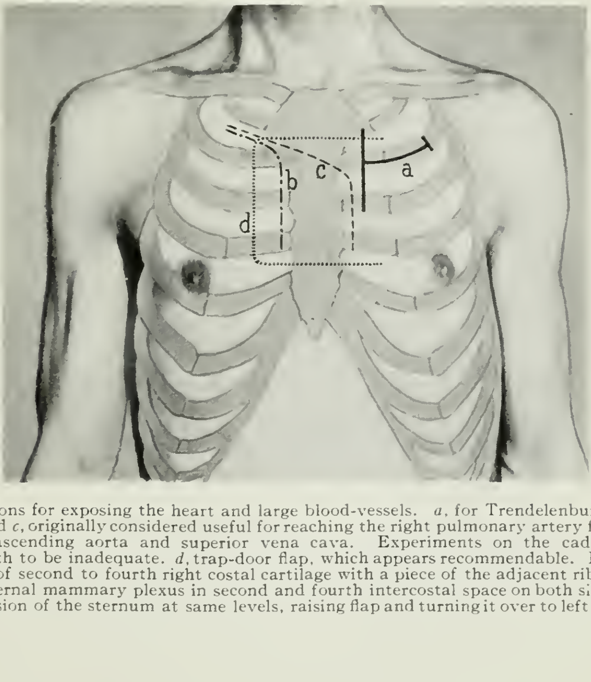
Trendelenburg's experience in animal experiments was obtained on calves, without the use of differential pressure; dogs were not considered suitable subjects. A piece of lung.

FIG. 1.



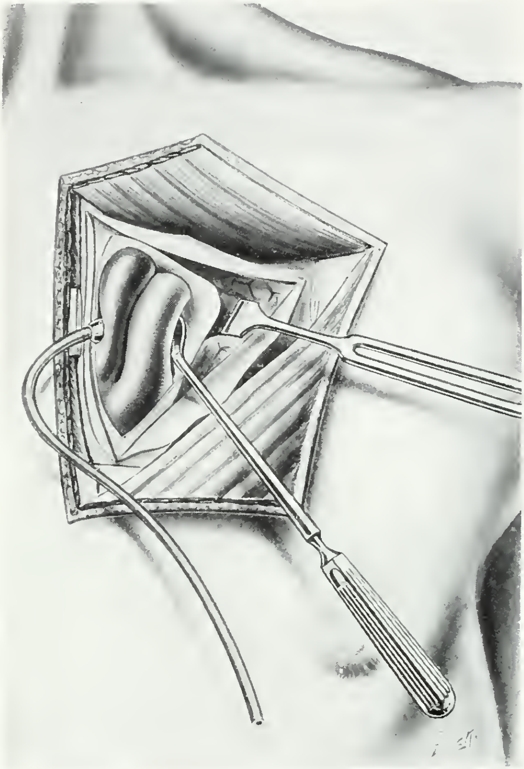
Heart seen from the right side. Note the upper entrance into the transverse sinus of the pericardium (which appears larger than normal, due to the process of hardening the specimen), also the transverse course of the right pulmonary artery behind ascending aorta and superior vena cava as well as its division at the right border of the latter vessel. (Taken from the book on "Topographic-Anatomy" by Oscar Schultze.)

FIG. 2.



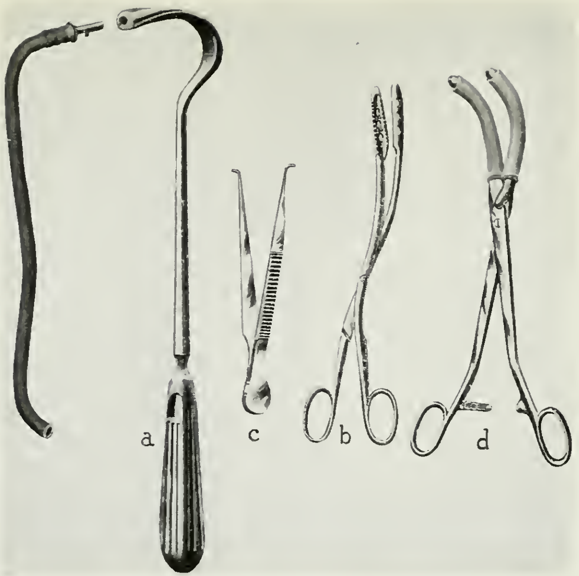
Incisions for exposing the heart and large blood-vessels. *a*, for Trendelenburg's operation. *b* and *c*, originally considered useful for reaching the right pulmonary artery for ligation between ascending aorta and superior vena cava. Experiments on the cadaver have shown both to be inadequate. *d*, trap-door flap, which appears recommendable. It involves resection of second to fourth right costal cartilage with a piece of the adjacent ribs, ligation of the internal mammary plexus in second and fourth intercostal space on both sides, transverse division of the sternum at same levels, raising flap and turning it over to left of patient.

Fig. 3.



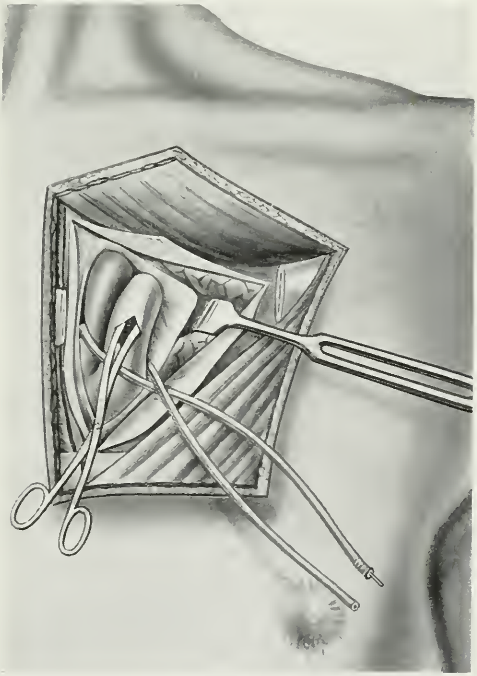
Trendelenburg's operation for the extraction of pulmonary emboli. ⊢ incision alongside left border of sternum, and over median portion of second left rib; the latter with cartilage resected; third costal cartilage divided. Triangular flaps turned back. Pleura incised; pericardium opened. Trendelenburg's large sound has passed through transverse sinus of pericardium, lifts pulmonary artery plus ascending aorta forward. Elastic tube screwed on; ready to be drawn around vessels.

FIG. 4.



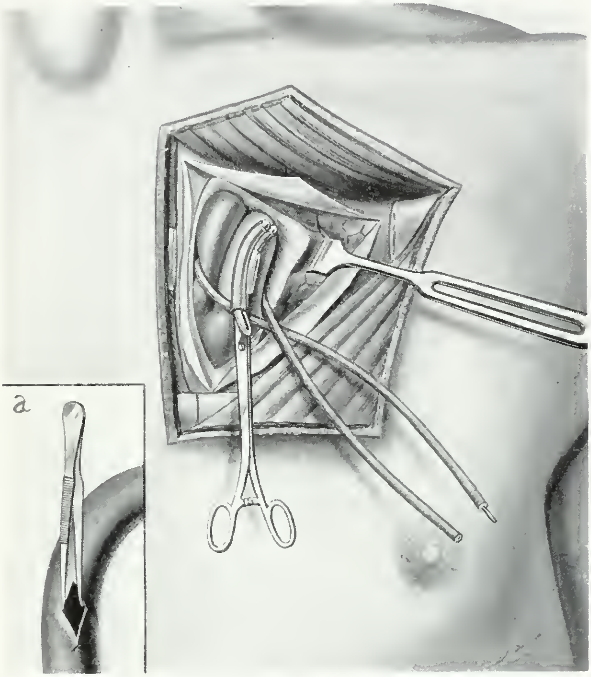
Instruments devised by Trendelenburg for his operation. *a*, large curved sound with handle, elastic tube detached; *b*, blunt pointed forceps for extraction of emboli; *c*, forceps with tips turned outward, which lift the borders of the incised wound of the pulmonary artery (see Fig. 6*a*); *d*, clamp with rubber covered branches, which closes the arterial wound (see Fig. 6).

FIG. 5.



Elastic tube tightened by assistant, compressing both vessels (not shown in illustration). Pulmonary artery incised and forceps introduced for extraction of emboli.

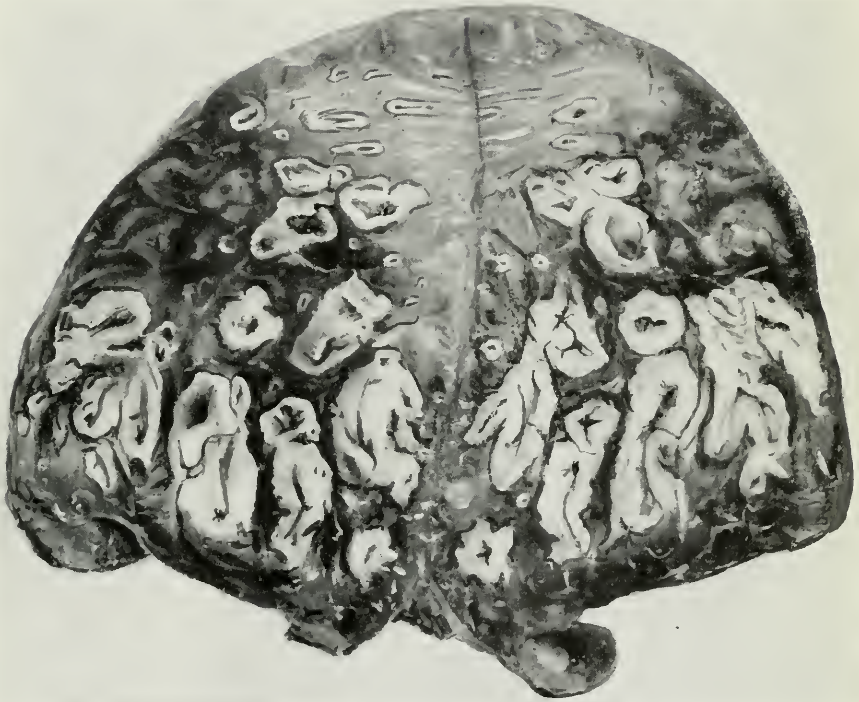
FIG. 6.



Longitudinal wound in pulmonary artery clamped laterally, permitting blood circuation alongside during the act of placing the interrupted sutures.

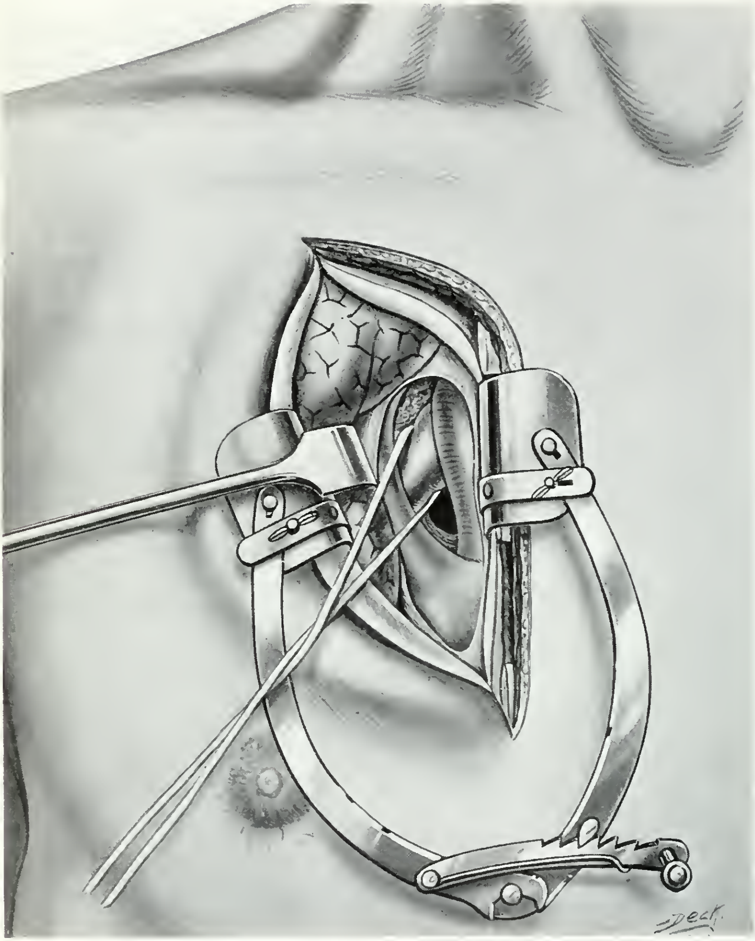
FIG. 6*a*.—Forceps introduced to facilitate lifting and proper clamping of artery.

FIG. 7.



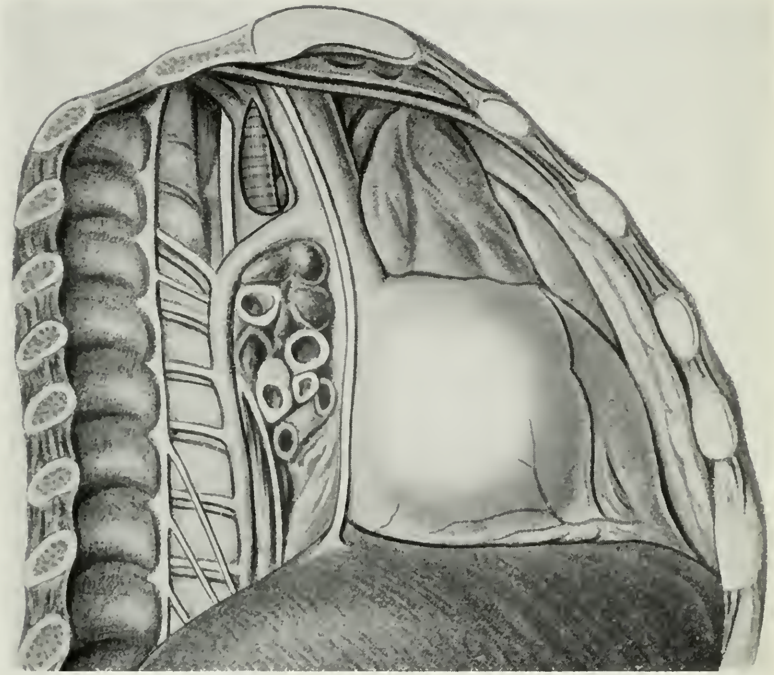
Bronchiectasis of inferior lobe of left lung, obtained by pneumectomy (personal collection). Actual size of specimen, divided by section cut. The pronounced distention and contortion of almost the entire bronchial tubes is well marked.

Fig. 8.



Ligation of right pulmonary artery within the pericardium. Illustration somewhat diagrammatic. Cadaver operation, with help of a curved combination incision through first right intercostal space and division plus resection of second till fourth costal cartilage with adjacent portion of ribs. Body turned on left side (not shown in picture), the right shoulder and hip being supported by blocks. Pericardial wound lengthened upward and to the right as far as the finger introduced will find an open space. This brings field of operation well into view. By retracting ascending aorta with a blunt hook toward the median line and the superior vena cava outward, the large right pulmonary artery, running horizontally across the field, becomes clearly visible in the depth.

FIG. 9.



Situs mediastinalis in a child, right side view. Almost the entire right half of the thorax removed, and right lung cut off at its root. Note right phrenic nerve running parallel with superior vena cava, also rectangular entrance of vena azygos into this vessel. Incision through costal pleura above vena azygos added; through this window the trachea is seen. Below the vena azygos appears the bundle of divided bronchi with branches of right pulmonary artery and vein. A few lymphatic glands hug the right border of the large vein. By pulling the angle between vena azygos and superior vena cava downward and to the right and the trachea to the left with a blunt retractor, the place is reached where the right pulmonary artery divides into an upper and lower branch, still within the pericardium. The right uppermost turn of the pericardium must first be divided before the division of the vessel comes into view. (Taken from the book on "Topographic Anatomy" by Oscar Schultze.)

1 cm. thick and 15 cm. long, was removed from another animal at the slaughter house, under aseptic precautions, and introduced through the deep jugular vein into the circulation, everything being in readiness for the subsequent work. As soon as the symptoms of pulmonary embolism became manifest in the narcotized animal, access to the pulmonary artery was obtained in the manner described above, and the embolus extracted; it had become lodged in the left branch of the vessel. The calf, eight weeks old, recovered from the operation (December, 1907). The specimen of the heart and adjacent large blood-vessels was obtained 3 months later and demonstrated before the German Surgical Congress at Berlin, April, 1908.

Shortly before this presentation the operation was carried out by its author for the first time in the human being. The patient, 70 years old, died before the operation was finished. Since then it was done, according to a personal communication from Prof. Trendelenburg, dated January 31, 1912, twelve times in all, at the Leipzig clinic, without one permanent recovery. One patient lived for four days; another one, operated upon by Krueger, survived the operation, but died five days thereafter of pneumonia.

Prof. Trendelenburg writes: "All new and difficult problems require much work, favorable conditions and unfaltering confidence and perseverance. This holds good also in the operation for pulmonary embolism. Twelve times have we done it at the clinic, my assistants oftener than myself, and not once with success. And yet, I would continue trying. This much we have learned from our cases, that the diagnosis in all *surgical* cases is easy; invariably did we find the emboli."

Trendelenburg's operation is nicely adapted to the endeavors of present times. The ideal way of dealing with an acute arterial embolism is to cut down on the seat of the thrombus after proper localization, remove it and close the rent of the arterial wall by suture. Trendelenburg deals with the most common of embolic troubles which, if left alone, is frequently fatal. He has succeeded in overcoming the technical difficulties that seemed at first glance to block the way. The steps of his operation are clearly defined.[2]

If it could be shown that patients can entirely recover after the operation, surgeons would, no doubt, be less inclined to temporize, but would operate as soon as the diagnosis has been made.

All operators speak of the enormous distention of the right ventricle of the heart after the onset of the catastrophe, which, as a matter of necessity, increases from minute to minute.

Trendelenburg's assistants, Laewen and Sievers, on the basis of experimental work, recommend artificial respiration with oxygen during the operation, and injections of adrenalin into the left ventricle, immediately after the elastic compression of the vessels has ceased.[3] They also found that whereas aorta and pulmonary artery can be compressed for 45 seconds only, the two venæ cavæ may be compressed for six to eight minutes without endangering life, a point which had already been emphasized by Sauerbruch previously. The explanation is that in the former case the distention of the right heart is added to the interruption of the circulation. On basis of these findings, Jeger[4] proposes compressing the two big veins, when carrying out Trendelenburg's operation, rather than the two big arteries. In his experiments along these lines he found that he could do the incision and closure of the pulmonary artery leisurely. The incision of the pulmonary artery brought immediate relief to the distended right heart. He thinks it might be still better to commence work on the heart with puncture of the right ventricle.

According to Trendelenburg, coagulation of the blood and recurrence of the embolic accident can be avoided by injections of hirudin.

His assistants, Rimann and Wolf, investigated this question.[5] They found that one milligramme hirudin prevents the coagulation of 5 c.c. of blood for four and one-half hours. This would mean for a patient of average weight 1 gramme (fifteen grains), at present a rather expensive procedure, as the cost of one gramme hirudin is almost twenty dollars. The drug, injected intravenously in large amounts, proved harmless.

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[2] See Trendelenburg: Centralbl. f. Chirurgie, 1907, pg. 1302; ibid., 1908, pg. 92, and No. 35, Beilage, pg. 3; Deutsche med. Wochenschrift, 1908, No. 27; R. Sievers: Deutsche Zeitschrift für Chir., vol. 93, pg. 282.

[3] Deutsche Zeitschr. f. Chirurgie, 1910, vol. 105, pg. 174.

[4] Die Chirurgie der Blutgefasse u. des Herzens, 1913, pg. 243.

[5] Deutsche Zeitschr. f. Chir., vol. 97, pg. 177.

Some authors have called Trendelenburg's operation of little practical value, because, if the embolus is large, the patients die within a few minutes, and if it is of smaller size, it often does not endanger life and the patients do not need operation.

However, according to Trendelenburg's experience, there remains a certain proportion of patients, at least 50 per cent., in whom only one branch of the pulmonary artery becomes obstructed at first, and death does not occur until 10–60 minutes after the onset of the embolic attack. These patients present a clear indication for his operation. At least 15 minutes are usually at the disposal of the surgeon. Assistants and nurses must be trained to recognize the attack.

Unfortunately, the ever-continuing rotation in the staff of doctors and nurses in the hospitals of our eastern states minimizes this help or makes it illusory. But wherever permanency of position has been introduced, pulmonary embolism will be readily suspected or recognized, after attention has been called to the pathologic picture.

There remains, to my mind, another serious obstacle, particularly in our country, viz.: the necessity of obtaining the consent of the patient or his relatives without which this operation should not be undertaken, as otherwise conflicts with the law might be incurred by the surgeon. To obtain the consent to such an eventuality prior to the performance of the first operation, will seriously embarrass the operator's position; to ask for it after the embolus has occurred, almost without exception means fatal delay.

At the last meeting of the Congress of German Surgeons, March, 1913, Schumacher presented the experience gathered with Trendelenburg's operation in Sauerbruch's clinic at

Zurich. He calls attention to the fact that the diagnosis of pulmonary embolism may be difficult because a suddenly occurring internal hemorrhage, also myodegeneration of the heart can produce like symptoms.

Regarding diagnosis he considers, next to the clearly demonstrable enlargement of the right heart, the accentuation of the second pulmonary sound of importance.

He distinguishes three classes of pulmonary embolism:

1. The one causing immediate exitus, which evidently is due to shock, as not infrequently only a partial thrombosis of the artery may be found at autopsy.

2. The one causing death within a few minutes. Here thrombosis is perfect, separating pulmonary and greater circulation. The right heart becomes quickly overdistended.

3. The one of protracted course, which is most frequently observed. Here one of the main branches of the artery and a subdivision become suddenly clogged; only gradually total obstruction sets in.

As a matter of fact only the third category will furnish cases with indication for operation, and the task of establishing this indication is rendered difficult on account of the experience that some of these patients get better under conservative treatment. He considers operation imperative if medical treatment fails to bring improvement.

Four times this operation was performed at the Zurich clinic, but the patients could not be saved.

How much less dangerous the use of differential pressure has rendered Trendelenburg's operation in experimental surgery and operations on the heart in general, is shown by the results of operations upon dogs—animals which were not considered as suitable for this purpose. Of three dogs operated upon by myself with the assistance of Dr. Martin Rehling, adjunct attending surgeon at the German Hospital, two recovered, although the instruments used in human beings had to be employed (by far too large a set for the smaller dimensions of the dog).[6] The third dog succumbed to the results of an empyema on the twelfth day after operation.

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[6] One of these dogs was presented before the New York Surgical Society, May 8, 1912.

Tiegel's apparatus appears to be best adapted for these emergency cases in man.

There certainly does not seem to be any good reason why Trendelenburg's operation should not be successfully performed in the future also on man. I feel sure that with the future evolution of thoracic surgery the large hospitals here and abroad will follow Trendelenburg's advice, to keep an instrumentarium for this work ready for instantaneous use in a specially labeled package, and make an effort to save also this class of patients, so often utterly lost without operative help.

II. *Intrapleural ligation of branches of the right or left pulmonary artery for bronchiectasis. Sauerbruch-Bruns.*

Bronchiectasis involves the bronchial tree, not the pulmonary tissue (See Fig. 7 and ANNALS OF SURGERY, vol. 52, pg. 40, Fig. 1). It is a frequent disease. In tuberculosis sanatoria and other places many patients are found who expectorate large amounts of pus and mucus, often mixed with blood and of foul odor and taste, in which, on repeated examination and inoculation of guinea-pigs, no tubercle bacilli can be demonstrated. The majority of these patients suffer from bronchiectasis. Clinical examination often brings out nothing characteristic except a few crepitant râles, usually over the lower lobe of one or both lungs; on the right side, the middle lobe is often also involved. Cases have likewise been found in which the upper lobe was affected.

Bronchiectasis is also a dangerous disease. Remarkable to state, sudden suppurative inflammation of brain and cord may follow in its wake. Personally, I have lost three such patients of a most acute purulent meningitis following preliminary incision of the lung for bronchiectatic cavities, from three to six months after the operation among ten patients thus afflicted. They died within 48 hours after the onset of the acute symptoms.

The clinical symptoms of bronchiectasis are not amenable to medicinal, serological or hygienic treatment, as in pulmonary tuberculosis. They gradually but continually remain on the increase. In most instances the exceedingly foul odor and taste of the sputum torment the patients and their families beyond expression; the frequency of the expectoration interferes with their night's rest.

With the advent of thoracic surgery, bronchiectasis has, therefore, clearly become a surgical disease, which *after* operation has to be considered a disease of the borderland.

Inasmuch as this article deals merely with the surgical aspects of the pathologic condition and more particularly with the surgery of the pulmonary artery, in respect of them only the operative procedures for bronchiectasis will be mentioned.

A. Artificial pneumothorax by insufflation of nitrogen into the pleural cavity.

This is a recommendable treatment where there are no adhesions and where the pulmonary parenchyma is the seat of the disease. But in bronchiectasis, in which the bronchial tree is the affected part, no lasting result can be expected from outside compression of the lung by gas. Vollard reports a case of bronchiectasis, treated with artificial pneumothorax for two years and a half (*Muench. med. Wochenschr.*, 1912, No. 32); the sputum was temporarily reduced; but upon discontinuance of the treatment the sputum promptly returned to its original quantity. More lasting results may be obtained by collapse of the lung by means of thoracoplasty.

B. Incision of the bronchiectatic lung abscess (pneumotomy).

Cures have been reported after this operation. They are exceptions, however. Usually the expectoration is for a time considerably reduced thereby, since a part of the bronchiectatic cavities drain through the chest wound. However, with advance in cicatrization, the sputum increases again. When cures have been actually obtained they have usually not been lasting, relapses having been frequently observed.

C. Partial thoracoplasty combined with pneumolysis, and transposition upward of the diseased lobe of the lung by suture, tamponade of the pleural cavity between base of lung and diaphragm with healing of the wound by granulation (Garré[7]).

D. Ligation of the branches of the pulmonary artery. Sauerbruch-Bruns.

Before the third International Congress at Brussels, September, 1911, Sauerbruch reported two cases thus treated. In his experimental work, done in connection with Bruns,[8] he had found that if the branch of the pulmonary artery which conveys the venous blood to the lung for ventilation was tied, in other words, if the physiologic function of that lobe was artificially inhibited, it would shrink, become adherent to the costal pleura and become transformed into a mass of connective tissue. When, later on, thoracoplasty is done, as in unilateral tuberculosis of the lung with cavity formation, the bronchiectatic cavities are compressed by the collapse and the proper, logical way for the improvement or cure of the trouble has been opened. Sauerbruch's patients, up to the time of the report, had been much improved.

So far I have employed this method in three cases. Their histories are here very briefly appended:

Case I.—J. C., male, seventeen years old; right lung, middle and lower lobe affected; expectorated for five years following attack of pneumonia; never T. B. found; lues negative; sanatorium treatment over two years; no improvement.[9] Clinical symptoms slight, point to right, middle and lower lobe; corroborated by X-rays. Quantity of sputum 350–400 c.c. in 24 hours; mucopus of foul odor, mixed with blood.

Operation (April 4, 1912).—Previous forced expectoration; regional anæsthesia, with novocain 1 per cent. + suprarenin (Hoechst's tablets, freshly dissolved), of fourth to seventh thoracic nerves, inclusive; negative chamber; expectorates almost 100 c.c. during the first three-quarters of an hour of operation. Left lateral position; incision in right, fifth intercostal space, after previous injection with novocain solution, painless; rib spreader put in place; patient still has no pain, but does not like to be awake, asks for general anæsthesia; granted, very superficial. Lung widely adherent, freed up to apex incl. (total pneumolysis); interlobar space closed by tight adhesions, cannot be entered; therefore, ligation of pulmonary branch above and at base of bronchus with silk. Closure of thorax. Patient returned to ward; primary union; out of bed four days later; quantity of sputum diminished; later slowly increasing. Soon goes to country; able to work.

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[7] Mittheilungen aus den Grenzgebieten, vol. xxiii, 3.

[8] Centralblatt f. Chir., 1908, pg. 1405.

[9] This patient was sent to the German Hospital for treatment through the courtesy of Dr. McSweeny, then physician-in-chief of the tuberculosis sanatorium in Otisville, N. Y.

January 17, 1913, increased weight; expectoration about 180 c.c. in 24 hours.

March 13, 1913, thoracoplasty, under regionary novocain anæsthesia; Schede's incision, lower half; sixth to tenth ribs inclusive, resected.

April 1, inhalation of superheated air begun by means of electric hot-air douche; brings little improvement. In near future second to fifth ribs to be attacked by columnar resection in paravertebral and mammillary lines (Wilms).[10] On the whole. patient improved, but so far not cured.

Case II.—F. N., male, seventeen years of age; expectorated for last five years following pneumonia. Left lower lobe involved; typical sputum; no T. B.; pronounced scoliosis. Nine months in sanatorium, without improvement.[11]

Operation (May 12, 1912).—Negative chamber; regionary anæsthesia, as before; expectorates freely during progress of operation; superficial general anæsthesia, which patient asked for, induced. Intercostal incision in fifth space. Lung adhesions not loosened; artery of lower left lobe identified and ligated (chromicised gut). Portions of lower lobe atelectatic; closure without drainage; soon rise of temperature; middle of wound re-opened; exit of turbid serosanguinous fluid; fever gradually dropped; healed slowly. Returned to sanatorium in July, where he still is; has gained 16 pounds in weight; daily amount of sputum 120 c.c.[12]

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[10] These operations were carried out on May 15, posteriorly, and May 31, anteriorly, under regionary anæsthesia. Primary union followed both operations. Patient is now ready to leave hospital (June 7).

[11] Referred through courtesy of Dr. Rathbun, the present physician-in-chief at the Otisville Sanatorium.

[12] May 15. Thoracoplasty under regionary anæsthesia. Ribs run almost perpendicularly upward. Large Schede incision required. Resection of tenth to sixth ribs inclusive; doing nicely; will soon return to the country sanatorium.

In view of the rigid asepsis carried out, it is assumed that possibly the pulmonary adhesions contained dormant encapsulated bacteria which became virulent after operation.

Case III.—T. M., male, twenty-two years; five years ago pneumonia; two months in bed; since then abundant expectoration; about one-half cupful every two hours, day and night, often mixed with blood, and of sweetish taste; sleep much interfered with; cannot attend to business; medical treatment brings no relief; clinical examination points to right lung, middle and lower lobe; radiography corroborates this; quantity of sputum 350–400 c.c. in 24 hours.

Operation (February 25, 1913).—Negative chamber; regional anæsthesia, third to sixth thoracic nerves; local in fifth interspace; work painless; rib-spreader produces feeling of pressure, but no pain; manipulations in thorax start cough. No adhesions between costal and pulmonary pleura. Interlobar space can be well entered; field deep; adhesions there clipped with scissors; lung tissue, drawn out into one of these adhesions, injured; exit of some purulent material; bronchus exposed; artery as usual, toward "north" of same; located and freed; two black colored lymphatic glands tightly adherent, loosened with difficulty; pronounced periadenitis; slight venous oozing; at this time a few drops of anæsthol were administered, 8 c.c. in all, but pulse rose; patient became cyanotic; anæsthesia stopped; better; silk ligature around vessel feeding lower lobe; search for artery of middle lobe not pressed on account of patient's condition. In view of contamination of pleural cavity, drainage decided on; counter opening in eighth intercostal space; short cigarette drain and two split rubber tubes introduced; main wound closed; rubber dam over drains; large dressing; differential pressure after treatment for 15 hours. First day satisfactory; then rise of temperature and subcutaneous emphysema of right side of abdomen and scrotum, also up to right side of neck; some dyspnœa. Third day middle of intercostal wound reopened; exit of serous fluid with air; no communication from drainage canal to upper cavity, into which two rubber tubes are introduced; lower lobe of lung had already become tightly adherent to chest wall; gradual improvement.

March 15: Beginning to inhale superheated air produced by electric hot-air douche, four times in 24 hours, gradually up to

40–45 minutes each time; improvement continues; sputum reduced to 30 to 60 c.c. within 24 hours. Wounds closed; has gained in weight; sleeps all night. Thoracoplasty deferred for the present.

Regarding the technic of the operation, it must be stated that it is not as simple in the human being as it is in the dog. In the latter the pulmonary lobes are clearly divided; broad, pleuritic bands, if present, can be easily and safely cut and the bronchus with accompanying vessels exposed. In man the lobes of the lung often form a unit, with adhesions between them, the thicker the oftener attacks of pleurisy have been experienced. The interlobar space can be entered, but the bronchus with its vessels is not always reached without injury to the lung tissue; and when thoroughly exposed, the bronchus may be found covered by a few enlarged and inflamed lymph nodes, as in my Case III, which render isolation of the artery in the depth difficult, if not impossible. Besides, the variations in the division of the pulmonary artery, so thoroughly discussed by Schumacher in his lucid article (*l. c.*) leave the surgeon in doubt whether all the vessels that should be tied have been tied.

In view of these facts the desire to reach the right and left arteries before their division into branches, viz., nearer the heart, was but natural. This desire has become all the more intense, since two patients with bronchiectasis lately have come under treatment, in whom a strict localization of the trouble has thus far been impossible. One has been operated upon repeatedly for a bronchiectatic lung abscess on the right side before coming under my care; the other has an affection also of the right lung with a pulmonary hemorrhage off and on, and clinical signs of disease pointing to the right middle and upper lobe.

The experimental work which I have carried out with Dr. Rehling within the last few months, has in part been directed toward the solution of this question. Anatomical studies have shown that it will be best for the purpose in view to ligate the trunks themselves, of either of the two arteries. This is best done within the pericardium.

III. *Intrapericardial ligation of the main trunk of the left and right pulmonary artery* (*experimental*).

In dogs it is a comparatively easy matter, after having entered the pericardium, through a left intercostal incision in the fourth space between the left phrenic plexus and the left pneumogastric nerve, to separate the left portion of the pericardium, after a very superficial incision of its turning fold, for about one centimetre from the left pulmonary artery, and then surround the vessel with a ligature. (Not infrequently the left pulmonary artery in dogs divides a few millimetres outside of the pericardium and can then of course be tied there to advantage.) Closing the artery suddenly has no influence on the heart's action and respiration, as proven by many experiments. If the ligature drawn around the vessel has not been tied, but made use of for gentle traction, the right pulmonary artery can be best surrounded with a thread below the left on its course downward and backward before it reaches the posterior aspect of the ascending aorta. The same can be accomplished from above the left pulmonary branch by preparing off the pericardium upward; but this manœuvre is dangerous, in view of the missing sheath of the vessels, and their great thinness (hemorrhage). The advance from below, therefore, has appeared safer to us. The first and most important rule for this work is, after the pericardial fold has been nipped, to proceed absolutely bluntly, with a curved forceps or scissors, slowly and gently. Only in this way can a sudden severe hemorrhage be avoided.

Work on human cadavers, done at the morgue, and made possible through the courtesy of Dr. S. W. Schultze, of the Board of Health, has shown us that the left pulmonary artery, with Trendelenburg's incision, is as thoroughly accessible in man as in animals, at least in the frozen cadaver, although the field of operation is pretty low if aorta and pulmonary artery have not been lifted up with a rubber tube in the transverse sinus of the pericardium (see above, Trendelenburg's operation). But the right main branch makes such a sweeping curve downward and backward that it seems unwise and unsafe to attempt here anything like what could be successfully done in the dog. A hemorrhage coming from the right pulmonary artery at this place would most likely mean the death of the patient on the table, except the quick temporary compression of superior and inferior vena cava would allow the operator to find the tear and close it by suture. We have, therefore, attempted to reach the right pulmonary artery on its further course. There are two ways open, one within the pericardium, the other outside of the same. The first place can be reached from the front, the latter from behind. Making it a postulatum that such an operation should not be too severe, the advance from behind has not been favored. We have, therefore, chosen in our experimental work to advance from the anterior side and ligate the artery within the pericardium in the following manner: Right intercostal incision in the fourth space; incision of pericardium (low down! to avoid hemorrhage), splitting of the pericardium upward until ascending aorta and superior vena cava are properly exposed. If these two vessels are then gently, without compressing them, separated with blunt retractors or the fingers, the right auricle being held down and its fibrillation kept under control with a small gauze mop, the transversely running right pulmonary artery becomes clearly visible in the depth (Fig. 1), and can be surrounded with a ligature (Fig. 8). At the present moment this kind of approach seems to us to represent the most favorable one. After some experience this ligation took us, from the beginning of the operation to the application of the dressing, half an hour; the dog recovered.[13]

A little further peripherally the right pulmonary artery divides into a superior and inferior branch which might be reached either from within the pericardium by pulling the main trunk, which is surrounded by a thread (Fig. 8), gently forward and toward the median line, retracting at the same time the superior vena cava outward, or outside of the pericardium through an incision of the pleura, right above the vena azygos (see Fig. 9 with legend). More experimental work must clear up this point.

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[13] Killed ten weeks after operation. Right pulmonary artery firmly closed by ligature. Upper and middle lobe tightly adherent to costal pleura, lower one still free. Pronounced increase of connective tissue in two upper lobes, less in lower (Report by Dr. Fred E. Sondern).

I would like to mention here a rather strange observation. After ligation of the main branch of the pulmonary artery (left) we had expected a reduced hemorrhage (return blood) on puncturing the blood-vessels that run on either side of the bronchus. This was not so. It bled freely so that we had to ligate. Where did this blood come from? We had beyond doubt securely closed the artery, for the vessel was divided between two ligatures, and when the dog was killed at the end of the experiment by stopping the differential pressure this point was carefully investigated and corroborated. It did not bleed synchronously with the respiration so that we could exclude distention and collapse of the lung being responsible for the phenomenon. It is further hardly conceivable that the small bronchial arteries, though coming directly from the aortic arch, should throw such an amount of blood into the lung as to produce a hemorrhage of such intensity; besides, as far as known, there exists no communication between pulmonary and bronchial arterial system, for obvious reasons, as the one carries venous the other arterial blood. The left lung also did not become so profoundly anæmic in several experiments as did the right lung after intrapericardial ligation (one observation). We had no time to repeat these experiments much to our regret, and did not test the branches of the right pulmonary artery alongside the bronchi, as we wanted our dog to live, if possible. I therefore mention the observation here for what it may be worth. If corroborated, then there must be some kind of collateral circulation in the left lung of the dog. And if the same anatomical condition should exist in man, it would help to explain how patients with partial or rather gradual severe pulmonary embolisms may recover.

In the human being the right heart is situated almost entirely behind the sternum. Trendelenburg's incision transferred to the right side will not give sufficient approach, not even in the cadaver. Longer incisions too (see Fig. 2, *b* and *c*) were found unsatisfactory. They may allow the operator to reach the right pulmonary artery in the upper part of the pericardium, but will never give him sufficient room in the living for satisfactory control of the deep-seated operating field in case of emergency. Only by means of a trap-door will the right heart and large blood-vessels within the pericardium become so thoroughly exposed that gentle handling and operating on them is rendered possible (see Fig. 2, *d*). The wall of the pulmonary artery and its branches is thin like that of a vein. In the frozen cadaver the Dechamp needle easily penetrates the vessel in the attempt of surrounding it. Dechamp's needle must have, for this work, a special length and special curve, also a very blunt point, in order to avoid hemorrhage. Perhaps it will be best for the operator to surround in the living patient the right pulmonary artery, which at this place is about the size of a man's thumb and flanked on either side with fat, with his right forefinger introduced from below upward. Extreme gentleness and careful, slow, and always blunt advance are absolute requirements. If men react as dogs, no shock will follow the tightening of the ligature. Whether a strong silk suture or a piece of tape or a fascia graft or even a small aluminum clamp should be made use of for closing the vessel only practical experience on the living can decide.

Two main questions arise with regard to this kind of ligation. One of them is: Is the disease sufficiently grave to warrant this intrapericardial ligation of the pulmonary vessels? The other is: Has the surgeon the right to cut off the flow of blood to the non-affected lobes of the lung? The first question can be answered decidedly in the affirmative: it is sufficiently grave. Experience must show whether dangerous reflexes might mar the result of the work in man; possibly an application of a 1 per cent. novocain solution, or even a stronger cocain solution at and around the field of operation, inside the pericardium, may help to overcome this danger.

More difficult is the answer to the second question. In order to render it, the pathologists must tell us whether the upper lobe is really entirely healthy in the majority of these cases. It is surely a fact that they have been found involved. But assuming, for argument's sake, that they are not, that they represent an unaffected part of the lung, then we know from experimental surgery that the sudden dropping out of the work of one entire lung, as in total pneumectomy, is so easily borne by the animals, that on the first day after the operation they bark and move about as vigorously as if nothing had happened. We have, as is well known, an abundance of lung and get along nicely with one lung. Naturally, if both lower lobes are the seat of the disease the peripheric ligation must remain the operation of choice.

Observations have not been carried out sufficiently long, of course, to allow conclusions as to the real value of the ligation of branches of the pulmonary artery in the treatment of bronchiectasis. We must not forget that the bronchial walls, which are the seat of the disease, are nourished by the bronchial arteries and that the pulmonary vessels attend to nothing but to transporting to the lung venous blood for ventilation. If after ligation of the main trunks, prolonged inhalation of superheated air and subsequent collapse therapy by means of thoracoplasty, the disease should not be cured, but the symptoms only alleviated, then this procedure should take second place, and all efforts should be concentrated on the last operative possibility:

E. Pneumectomy. Personally I believe that we shall learn to do this operation also in the human being with less danger than many investigators have attached to its performance. If the vagus reflexes and those from the sympathetic system can be overcome, possibly also with the help of cocain or its derivatives, there is no reason why man should not stand the operation as well as animals, since we have learned how to make the bronchial stump air-tight after amputation of the lung. Efforts of surgeons operating in this field will certainly move in that direction in the near future.

SARCOMA OF THE CHEST WALL.*

BY FRED B. LUND, M.D.,
OF BOSTON, MASS.,
Surgeon to the Boston City Hospital.

Operations for tumor of the chest wall have always been among the comparative rarities of surgery.

Tumors of the chest wall, ribs, and sternum may be divided into primary tumors: fibroma, chondroma, sarcoma, and their combinations, and secondary tumors: sarcomata and carcinomata.

The primary tumors are of considerably greater interest. The diagnosis is ordinarily very simple, and reduces itself merely to the existence of the tumor. Pathologically they are chondromata, chondrosarcomata, osteosarcomata, or mixed tumors. The growth is always about the same. They appear almost always at about the middle of the thorax (Molimard). In thirty-nine cases in which the position was accurately indicated the tumor was located only three times on the first rib and six times on the second. They are more apt to be located on the sixth, seventh, and eighth ribs. They appear over the rib on either side, and usually involve the rib above and the rib below. In those thirty-nine cases, Molimard found one rib involved only nine times; two ribs, six times; three involved fifteen times; and seven ribs involved four times. While spreading on to the ribs, the tumor mass ordinarily does not attack the skin or the muscles.

For a long time usually the tumor expands first outside the chest, so that the intercostal vessels and nerves are not affected. Occasionally the growth of the tumor inward is attended by great pain due to involvement of the intercostal nerves. At first the nerves are lifted up, but finally both vessels and nerves are surrounded by the tumor. The tumor does not invade the lymphatics, but extends by direct growth along the intercostal space toward the sternum and the posterior end of the ribs. Sometimes the vertebral bodies may be attacked without its being seen on the outside. After expanding for a certain length of time on the outside these tumors extend inward and project into the intercostal space. The pleura over them is thickened at first, and finally invaded by the tumor. The visceral pleura is rarely involved because the tumor does not become adherent and extend over to the lung. The lung, as in the cases reported in this paper, may be deeply indented by the tumor without becoming adherent to the pleura. In rare cases, adhesion of the visceral pleura and invasion of the lung does, however, take place. Numerous authors have reported removal of a portion of the lung in the removal of these tumors, among whom may be mentioned Voutier, Tropinow, Sedillot, Helferich, and others. Nevertheless, the direct invasion of the lung by the tumor even when the lung is adherent is rare. Invasion of the pericardium also is rare, but extensions to the diaphragm are more common.

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* Read before the American Surgical Association, May 7, 1913.

The dangers attendant upon the opening of the pleura in the early days were very great. Of the very few cases reported in literature in the pre-aseptic period, almost all died. If they survived the hemorrhage and shock of a formidable operation with opening of the pleura, they died of infection; and in the early days of the antiseptic method, they began to die of carbolic acid poisoning. Naturally, tumors of the chest wall were allowed to attain a great size before the danger of an operative attack was thought to be justified, and the mortality of the operative cases was high. The shock of operating upon the chest wall is great in proportion to that in other parts of the body: 1. Because of the interference with respiratory rhythm; 2. The nearness of the heart and great vessels; and 3, and most important, to the fact that when the pleura is widely opened there is interference with respiration and circulation on account of the sudden collapse of the lung. The collapse is due to the altered conditions of pressure. The mediastinum with its great blood-vessels and nerves is deflected to the opposite side,—less in man than in animals, it is true, but enough to be a cause of severe shock.

If these untoward conditions be overcome, there is the danger of infection in the pleural cavity, especially if, as was usually the case when drainage was employed, the lung was left collapsed at the end of the operation so that the closure of the cavity was impossible, and empyema,—bad enough in any case, but worse still when attacking a patient whose lymphatic spaces had been opened up by an extensive and mutilating operation,—was almost certain to follow.

Asepsis, modern instruments, and improved technic have, however, of late years gradually diminished the dangers of hemorrhage and infection; while during the last fifteen years, the improvements in our method of maintaining the expansion of the lung during the operation by positive pressure, Fell O'Dwyer apparatus, the positive and negative pressure cabinets of Sauerbruch, Brauer, and others, culminating in the almost ideal method of intratracheal anæsthesia, have removed the chief dangers of operative interference. The X-ray has enabled us to make an early diagnosis, and tells us whether we must be prepared for an extensive opening in the pleura or not; so that it is now our own fault if we do not deal with these cases better than did our predecessors.

In 1898, F. W. Parham, of New Orleans, published a most thorough and scholarly report of what had been accomplished from the dawn of time in the surgery of the thoracic wall. He had at that time operated upon two tumors of the thoracic wall requiring extensive opening of the thorax, and was obliged in the first case to combat severe shock which instantly supervened when the thorax was opened. In the second case, he employed the Fell O'Dwyer apparatus for inflation of the lungs, and was enabled to prevent collapse of the lung, dispense with irregular respiration and shock, and at the end of the operation, to suture the lung around the margin of the opening in the chest wall so that it was maintained in expansion. In his most thorough and inclusive article, Parham reports all the cases of surgery of the chest wall in which the pleura had been opened, published up to the time of his own cases,—only fifty-two in number—and analyzes them from every point of view. The chief point of practical interest was the study of the effects of the pleural opening. A small pleural tear quickly controlled by stopping the opening with gauze or other pads was shown to have produced little shock. The presence of adhesions prevented shock by inhibiting collapse of the lung. The wide opening of the pleura, with the sudden entrance of a large current of air, intensified the shock to an extreme degree. The methods by which this had been controlled had been the covering of the pleural opening by the finger, compresses, or suturing; traction of the lung into the opening, stitching the lung into the opening (Tuffier, Beyer, and Parham); substitution of temporary hydrothorax for pneumothorax (Witzel); injection of sterilized air (Lowson); Quenu and Longuet's intrabronchial tension; O'Dwyer's method, etc. Parham speaks enthusiastically for the Fell O'Dwyer apparatus; yet after his paper was published, various operators (Rixford, Porter, and others) reported cases of tumor of the chest wall successfully performed without special apparatus, in which various rough expedients were adopted to close the opening in the chest. Perhaps this was because the cases were so rare that when they presented themselves few surgeons had the special apparatus at hand.

Then came the important work of Sauerbruch, Brauer, Willy Meyer, Robinson, and others, which provided us with pressure cabinets, the cumbersome nature and expense of which, in proportion to the rarity of the cases in which they were of benefit, precluded their general adoption; and then the intratracheal anæsthesia, which places within the reach of every surgeon a safe and simple apparatus which does everything that the pressure cabinet does and even more safely for the patient. The superior safety of this method lies chiefly in the fact that with the catheter in the larynx and the air current rushing outward around it, neither mucus, nor blood, nor œdema, nor dropping of the tongue, nor even cessation of the respiratory movements can interfere with the air exchange. The apparatus is useful for so many other conditions beside lung surgery,—neck, tongue, mouth, pharynx, cerebrum, etc.—that it is in almost constant use in large clinics where it is employed at all.

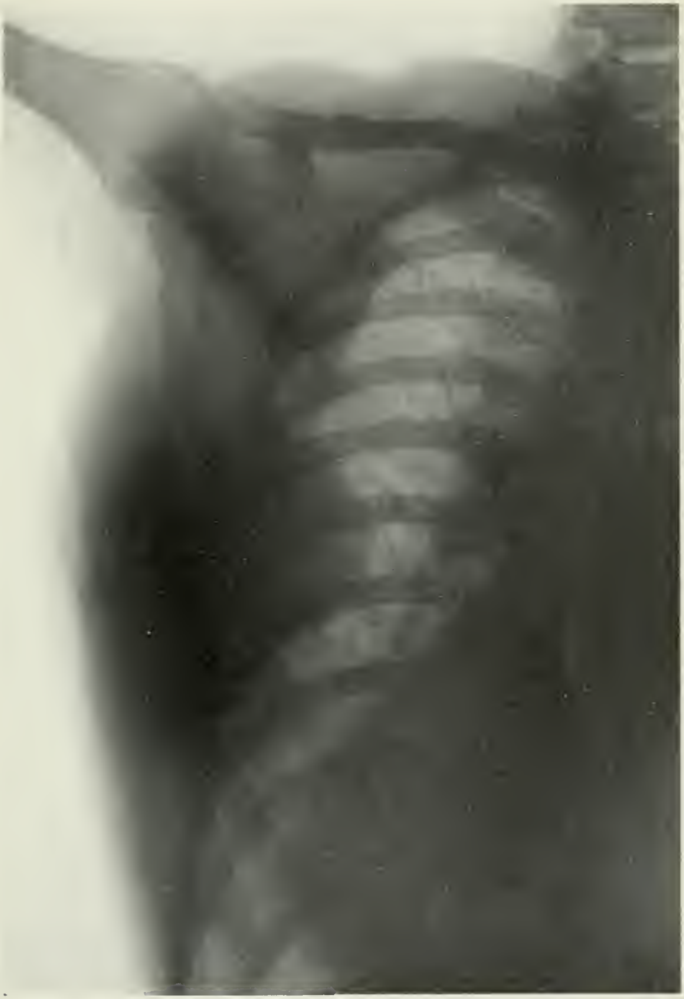
My own excuse for reporting the case which follows is, first, the rarity of these cases; second, the exact pre-operative diagnosis which the X-ray enabled us to make; third, the extreme simplicity of the operation, and the ease with which the lung was kept in expansion with a widely opened thoracic wall; fourth, the fact that I have so far found few reported cases of chest surgery under the intratracheal method in which there were no adhesions, the lung being entirely free; and fifth, that it illustrates the importance of dispensing with drainage in these cases.

S. P., about thirty-three years of age; housework: A tall, delicate, somewhat anæmic woman. Had noticed three years before a tumor under the left arm, which at first was quite small and had recently grown rather fast.

Examination showed that she had hypertrophy of both breasts, and in the right axilla attached to the chest wall was a mass about the size of a baseball. X-ray showed that this mass projected inside the chest (Fig. 1).

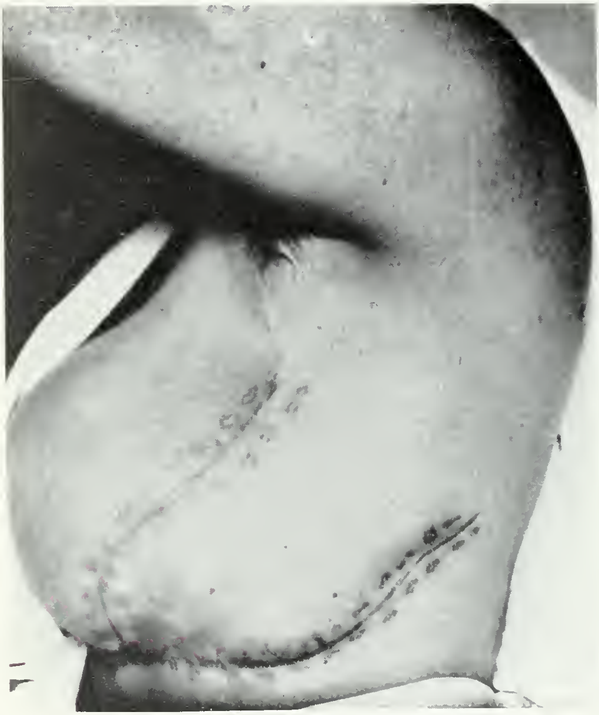
At the Corey Hill Hospital, on June 19, 1912, I made a curved incision in the left axilla, starting at the level of the second rib, at the lower border of the latissimus dorsi, carrying it six inches forward on to the breast, then downward about four inches, then backward to a point below the beginning of the incision. On turning this flap backward and dissecting free the pectoralis major and latissimus dorsi from the tumor, I surrounded the tumor, taking great care not to peel the subcutaneous tissue from its surface but leaving it attached. The third, fourth, and fifth ribs were then divided by an osteotome, in front of the tumor, the pleura being widely opened. Then the ribs were divided behind the tumor, and the tumor with about six inches of these ribs removed. The operation was

FIG. 1.



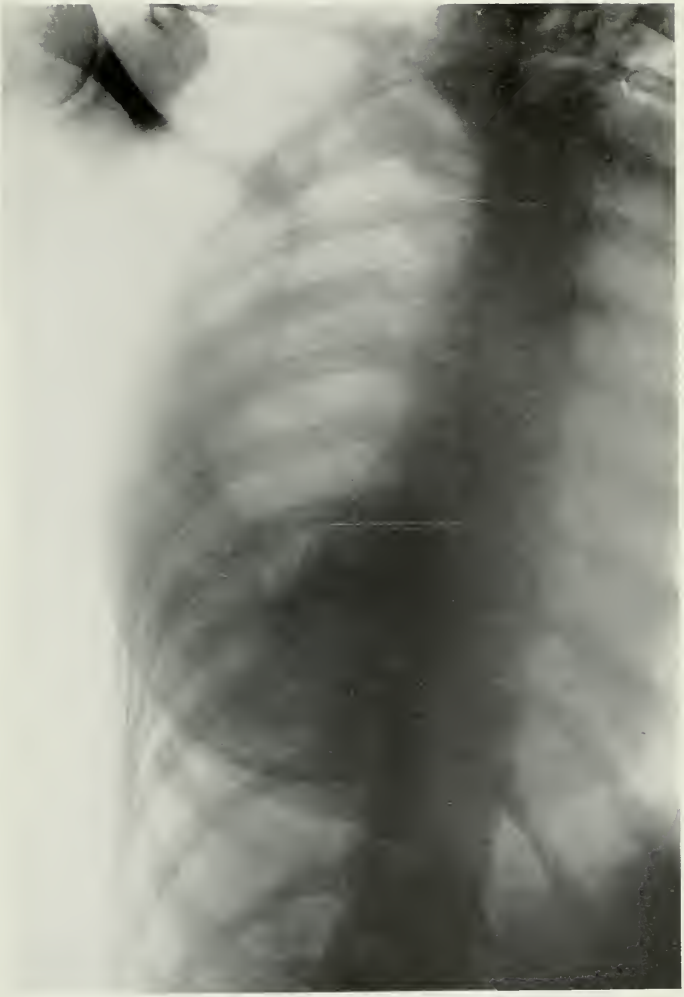
X-ray of patient before operation, showing tumor.

FIG. 2.



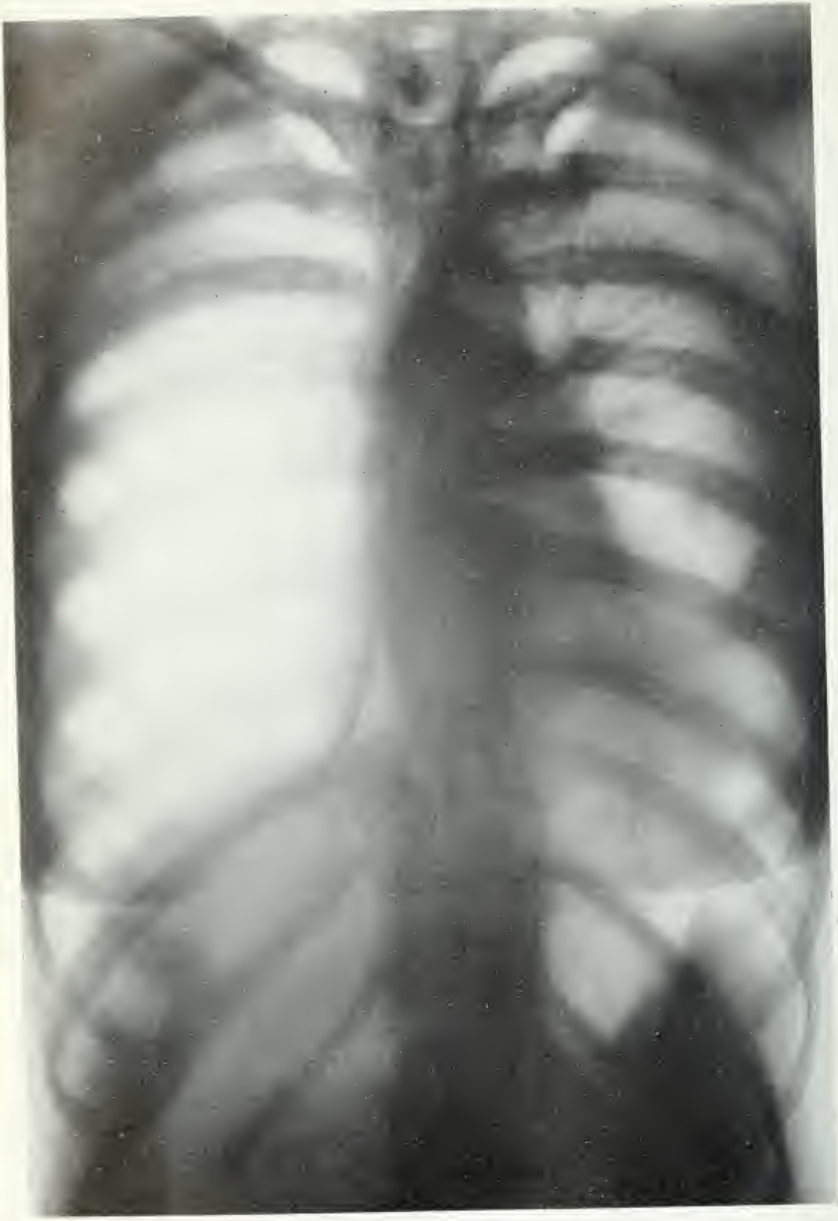
Photograph of patient after operation, showing incision.

Fig. 3.



X-ray of left chest taken October, 1912, four months after operation, showing absence of tumor.

FIG. 4.



X-ray taken April, 1913, showing thickening of the pleura and absence of tumor.

Fig. 5.

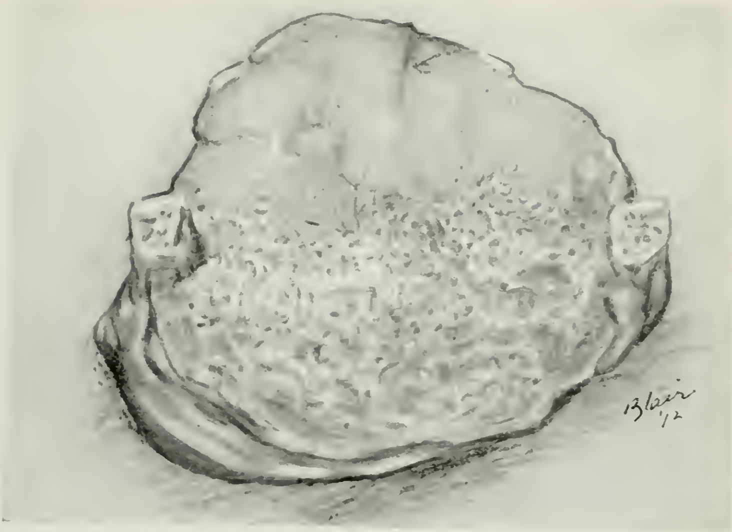
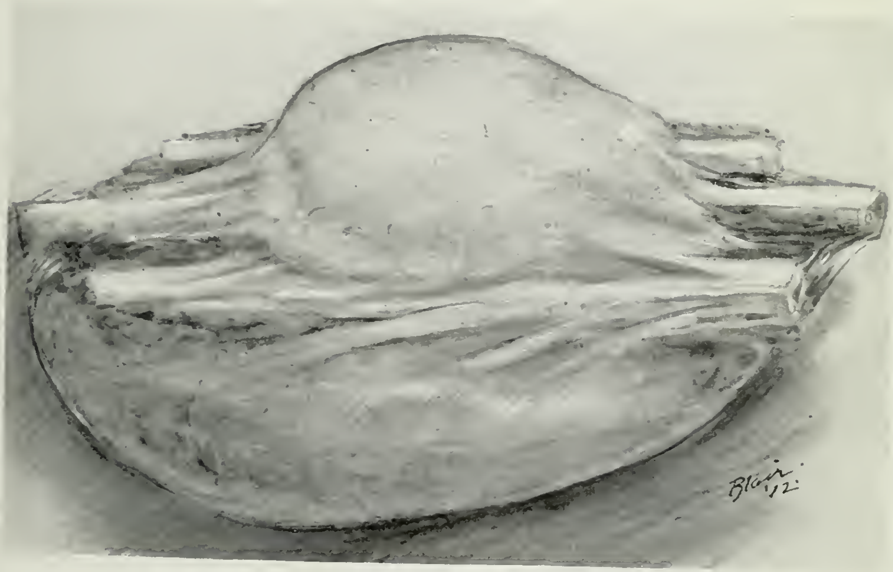


Fig. 6.



Figs. 5 and 6.—Specimen of sarcoma of ribs.

done under intratracheal anæsthesia, and the lung was kept continually blown up with the bellows until its close. It being then necessary to sponge out some blood which had run into the pleura, the lung was allowed to collapse and the cleansing of the pleura was easily accomplished. There was a good deal of hemorrhage from the muscular tissue. The intercostal arteries were tied and all hemorrhage stopped as far as possible; then, the lung being blown up so as to fill the pleura entirely, the greater pectoral and latissimus dorsi muscles were sewn together across the opening with interrupted sutures of catgut. The skin was then sewn with a Bartlett suture of silkworm gut (Fig. 2).

The patient bore the operation well and was in good condition the next day. On the second day, her breathing became rapid and irregular, and she became somewhat cyanotic. I found some dulness over the lower part of the pleura, tapped the chest, and after removing about nine ounces of blood, the symptoms were relieved.

Two days later, the symptoms returned to a slight extent, and I again tapped the chest, and this time got four ounces. The patient ran a rather rapid pulse, 100 to 120, and a slight temperature for two weeks. This temperature was undoubtedly due to absorption of blood clot.

It is possible that the negative pressure caused by tight suture of the pleura may have at first tended to increase the hemorrhage but I do not believe that this was a serious factor. There was slight dulness over the lower part of the chest and bronchial respiration over the upper part, the upper back, the middle back, and the upper front. The temperature fell to normal at the end of two weeks, and the wound healed by first intention. She went home in three weeks and has since been well. I present an X-ray (Fig. 3) taken in October, 1912; and another one (Fig. 4) taken in April, 1913; showing a slight shadow on the left, probably due to thickening of the pleura, but the entire absence of any signs of tumor, the ends of the ribs showing clean edges where they were cut off (Figs. 5 and 6).

A brief review of the literature since Parham's paper in 1898 shows that twenty-eight cases have been reported.

Among the more interesting communications on tumors of the chest wall is an article by Rixford in the *Transactions of the American Surgical Association,* 1905, volume xxiii, in which he reports four cases of resection of the chest wall for recurrent carcinoma of the breast, and one of sarcoma of the clavicle involving the first rib and sternum. He used a wet towel tucked under the opening in the chest as soon as it was made to occlude it, thus closing the opening and checking the lateral excursions of the lung and mediastinal tissues. The towel was folded on itself two or three times, and slipped beneath the partially loosened section of the chest wall at the moment of complete expiration when the chest was largely emptied of air; and in all the cases there were no untoward symptoms from pneumothorax. No drainage of wounds or pleura.

Rehn, *Archiv. für Klinische Chirurgie,* 1906, 81, p. 362, reports three cases of tumors of the chest wall, involving the removal of large portions thereof. He considers the operation dangerous. Campo, he says, has collected reports of 57 cases, of which 11 died as a direct result of the operation. Removal of chest wall tumors when the pleura is not opened is not a serious matter. Opening the pleura is in itself serious, and only one recovery is reported in literature where both pleuræ were opened: that of Franz König. Rehn advocates suture of the lung to the pleura with a large curved needle before opening the latter; and as soon as the pleura is opened, drawing the lung out with the hand by means of warm, moist compresses. At the close of the operation, he sutures the lung to the chest wall, and closes the skin without drainage.

Dollinger produced pneumothorax by making a cut into the pleura several days before the removal of a tumor of the chest wall, so that it may not be immediately produced at the time of the operation.

Sauerbruch reports two cases of resection of wall of thorax for carcinoma of mamma; one was adherent, one a recurrence after removal of a breast cancer. In the first case, the breast and infiltrated soft spots were removed with resection of two ribs. A flap of skin from the side was laid upon the lung with no distortion, and healed normally in place. The flap was the size of the palm.

In the second case, three ribs were removed, with soft parts, leaving an area thirty centimetres long by twenty-one centimetres wide, and pleura also to this whole extent. No pleural adhesions, and sound lung. The large area was covered by a flap from the side and transplantation of the opposite breast. Good recovery of patient and gain in weight.

C. B. Lockwood, in *The Clinical Journal,* September 25, 1907, reports two cases of tumor of the chest wall, one a carcinoma following carcinoma of the breast. The patient with carcinoma of the chest wall, in which several pieces of several ribs had to be removed and the pleura opened widely, recovered and was well for a year. The second case was one of spindle-celled sarcoma of the chest in a girl of seventeen years. Portions of the fifth, sixth, seventh, and eighth costal cartilages were removed. The diaphragm was infiltrated and the peritoneal cavity opened, and the apex of the pericardium also removed. There was some shock at the time the pericardium was opened. A portion of the lower lobe of the left lung was removed. Hemorrhage from the lung was stopped by a cautery. After removal of the tumor and closing of the opening in the peritoneum and pericardium, the thoracic wound was closed without drainage. There was very severe shock. The patient rallied, recovered, and was well six months afterward.

W. O. Roberts, *Louisville Journal of Medicine and Surgery,* January, 1906, speaks of thoracic resection for tumor growing from the bony wall of the chest. Found a small tumor, and the rib from which it was growing was removed.

Other cases reported in the literature will be found in the following table. On looking these over, it will be seen that as far as the table goes, there is little difference in the above as to whether Sauerbruch's cabinet was used, or the pressure apparatus, or simply closing the pleura with compresses. It will be found, for instance, that there were 28 cases reported, of which 26 recovered and only 2 died,—a very small mortality; that in only 3 of the cases was either the Sauerbruch cabinet or positive pressure employed; closure of the opening by compresses or traction on the lung was employed in 11 cases; shock was present in 9 cases, absent in 13, and not mentioned in 6. Murphy's positive pressure apparatus was employed in one case.

These are all the cases that I have been able to collect since the publication of Parham's paper in 1898.

As far as one can tell, the sudden wide opening of the pleura tended to produce shock, and the opening of the diaphragm produced shock whether positive pressure apparatus was or was not used. I think there is no doubt, however, entirely irrespective of statistics, that in cases of equal severity those operated upon with positive or negative pressure would do better than the same cases operated upon with-

Abstracts of Reported Operations for Sarcoma of Chest Wall.

Name and Date.	Operation.	Method contra Pneumothorax.	Shock.	Result.
Webber (*Lancet*, 1900, ii, p. 1347).	Removal of sixth left rib with tumor. Left pleura and pericardium freely opened. Left lung collapsed.	Not mentioned.	Not mentioned.	Recovery in spite of bronchitis.
LeDentu (*Bull. et Mem. de Soc. de Chir. de Par.*, 1902, 28, p. 244).	Removal of parts of 3 ribs for chondrofibroma with small portion of diaphragm.	Traction on lung. Pleura opened freely and as late as possible. Drainage of pleura. Suture of lung to skin flap.	Marked on opening pleura.	Double pneumonia followed, which still existed at date of report, 2½ months after operation.
Griffith (*Lancet*, 1902, ii, p. 991).	Resection of sternum from 2d to 7th costal cartilages. Left pleural cavity opened. Growth (sarcoma) not completely removed.	None. Pleural opening could not quite be closed by sutures.	Slight........	Recovery from operation. Death 4 mo. after.
Delorme and Piollet (*Lyon Med.*, 1902).	M.30. Tumor attached to 7th, 8th, and 9th ribs. Removed. Pleura widely opened. Lung retracted deeply. Small gauze drain in pleura.	No apparatus..	No shock.....	Recovery.
Israel(*Berl.klin. Woch.*, Mar., 1903, No.22).	Removal of a tumor of the body of the 6th dorsal vertebra. Small opening of pleura was made.	Opening stopped up with gauze packing.	No shock.....	Recovery.
Reeve (Annals of Surgery, 1903, 37, p. 724).	Resection of 3 ribs on right for tumor. Opening in pleura size of 2 hands. Diaphragm injured but not opened.	Not stated....	No shock.....	Recovery.
Rixford (1905. *Transactions, Am. Surg. Assoc.*, vol. xxiii).	Four cases: 3 of carcinoma of chest wall secondary to breast carcinoma. One sarcoma of clavicle involving 1st rib and sternum.	Hot, wet towel tucked under edges of opening so as to close it as far as possible.	Not present on opening pleura.	All recovered.
Deruginsky (*Am. Surg.*, 1906).	1st: removal of parts of 8th and 9th left ribs.	Gauze tampon.	Did not ensue upon opening pleura.	Recovery.
	2d: removal of all left thoracic wall from 7th to 11th ribs with a portion of diaphragm.	Gauze tampon.		
Torek (*Post Graduate*, N. Y., 1906, p. 335).	Removal of 4th, 5th, 6th, and 7th ribs for sarcoma, with portion of lung. Numerous metastases in pleura and lung.	None.........	Severe........	Death from shock.
Rehn (*Archiv. klin. Chir.*, 1906, 81, p. 362).	1. Removal of portions of 3rd, 4th, 5th, and 6th ribs for recurrence after carcinoma of the breast.	Lung drawn out and sutured to chest wall.	None.........	Recovery and long freedom from relapse.
	2. Removal of 12 cm. of 4th and 5th ribs, (Right) for sarcoma.	Lung drawn out and sutured to opening in chest wall.	None.........	Recurrence. Death from secondary operation, 3 months later.

ABSTRACTS OF REPORTED OPERATIONS FOR SARCOMA OF CHEST WALL—Cont'd.

Name and Date.	Operation.	Method contra Pneumothorax.	Shock.	Result.
Rehn (*Archiv. klin. Chir.*, 1906, 81. p. 362).	3. Removal of a sarcoma of the size of the fist with the 2d and 3d ribs on the right.	Lung drawn out and sutured to opening in chest.	None.........	Recovery. No recurrence in a year.
Roberts, W. O. (*Louisville Jour. of Med. and Surg.* Jan. 1906).	Removal of a tumor of the chest wall with attached rib.			
Lockwood, C.B. (*Am. Jour.*, Sept., 1907).	1. Carcinoma recurrent after breast carcinoma.	Nothing done to prevent pneumothorax.	Very severe...	Recovered and was well 6 months afterwards.
	2. Spindle-celled sarcoma in girl of 17. Two portions of 5th, 6th, 7th, and 8th cartilages were removed. Diaphragm was opened, and apex of pericardium removed. Some shock when pericardium was opened. Portion of lower lobe of left lung removed. Hemorrhage from lung stopped by cautery.	Nothing done to prevent pneumothorax.		
Hoffman (*Beiträge, z. klin. Chir.*, 1908, p. 182). Operation by Kuttner.	Removal of sarcoma of 5th, 6th, 7th, and 8th ribs, with spontaneous fracture of the 5th rib, from an 18 year old girl.	Sauerbruch cabinet.	None.........	Recovery.
Molimard (*Faculté de Med. et Phar. de Lyon*, Tome, 9, 1908). Operator, Poncet.	M. 18, Sarcoma of 7th, 8th, and 9th ribs. Diaphragm injured and closed by suture.	No apparatus..	Not stated....	Recovery.
Porter (*Boston Med. and Surg. Jour.*, Dec. 24, 1908).	Enchondroma of 6th, 7th, 8th, and 9th ribs; removed with injury to and suture of diaphragm. Lung sutured to intercostal muscles at close to prevent retraction.	Dr. F. T. Murphy's positive pressure box.	None on opening pleura.	Death, pneumonia, 14th day.
Hoffman (*Beiträge z. klin. Chir.*, 1908, p. 182). Operation by Kuttner.	Resection of two ribs for recurrent carcinoma.	Sauerbruch cabinet.	None.........	Recovery.
Menistrina, J. F. (*Med. Fortnightly*, St. Louis, 1909).	M. 55. 6th, 7th, 8th, and 9th ribs removed for sarcoma.	Pleural cavity opened slowly and packed off with gauze.	Slight........	Recovery.
Huguier and Rigollot-Simonnot, Paris, 2, 1910.	M. 52. Chondroma of chest wall, involving 7th, and 8th ribs which were removed with it. Resection of a portion of the diaphragm.	Pleura opened slowly. Lung sutured to ribs.	None.........	Recovery. Chest had to be tapped twice to remove blood.
Pier (*Deutsche med. Woch.*, 1911, No. 24).	M. 15. Removal of carcinoma involving 3 ribs, and resection of a portion of diaphragm.	Brauer's positive pressure cabinet.	Severe, but checked when opening in diaphragm was sutured.	Recovery.

out special apparatus; and also that the same cases operated upon under intratracheal anæsthesia would do still better than in the cabinets, and at vastly less expense and trouble. I feel, indeed, that we can hardly better express the contributions of the intratracheal addition to thoracic surgery than in the words of Gosset: "La peur du pneumothorax ira retrouver la crainte du peritoine."

I wish to acknowledge my indebtedness to Dr. Samuel Robinson for his kindness in letting me see his cases in consultation and for furnishing me with references to literature.

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ACUTE PERFORATING SIGMOIDITIS IN CHILDREN.*

BY JOSEPH RANSOHOFF, M.D., F.R.C.S. (Eng.),
OF CINCINNATI,
Professor of Surgery, University of Cincinnati.

Although our knowledge of acute and chronic inflammations of the sigmoid as distinct surgical entities dates back less than twenty years, case reports have been so numerous that to present another to the association would be without justification, unless it presented some unusual features. In nearly all cases, at least in adults, the immediate cause of the acute inflammation is an obstructed diverticulum which shows *a priori* that an acute process has been grafted on a chronic one. In the majority of cases the chronic process which leads to diverticulation does not make itself manifest, until obstructive symptoms arise or until a gross perforation or a pericolic infection through a still unbroken but permeable wall takes place. How innocuous a chronic diverticulitis may seem is shown by the case of Brewer [1] in which two operations, six years apart, were performed on a patient who seemed perfectly well in the interval. This latency of a condition potential of great disaster is a not unimportant one of the many points of analogy between inflammatory conditions of the two lower abdominal quadrants. That an analogy, one might almost say an identity, of the sequences of the pathologic processes in the appendix and the sigmoid diverticulitis exists may be assumed as absolute, although according to Powers [2] hardly more than a dozen cases of acute diverticulitis operatively treated have been reported.

In a negative way the analogy might be continued, for as suppurations in the right lower quadrant may originate in the intestine independently of the appendix, so I take it that in more frequent instances will suppuration about the sigmoid colon develop without a diverticulum as the primary cause. All the reported cases of diverticulitis which I have been enabled to examine have been in adults, mostly in males in mid-life and given to obesity. It is almost impossible to conceive of an acquired diverticulum in a child, wherefore, I have designated the following case one of perforating sigmoiditis.

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* Read before the American Surgical Association, May 8, 1913.

Case I.—R. H., aged three years, male. Was admitted to Jewish Hospital at 8 p.m., October 22, 1912. During seven days before his admission he had been under the observation of Dr. Bird, of Greensburg, Ind., to whom I am indebted for the following history. While in the hospital Dr. Rachford was consultant.

Family History.—Father had tuberculosis of knee, mother had tuberculous glands of the neck up to her fifteenth year. Two older children had always been well. The child had always been well save for a marked tendency to constipation.

The present illness began as a slight indisposition with loss of appetite and marked constipation. This was attributed by the mother to her failure to pasteurize the milk as had been her custom up to the onset of the present illness. The evening temperature was 100 and pulse rate between 90 and 100. Constipation was the marked symptom. The exhibition of castor oil and saturated solutions of magnesium sulphate together with high enemata failed to effect. The highest temperature recorded up to the fourth day was 101. Satisfactory examination of the abdomen could not be made since any effort to make it brought forth violent crying spells. On the fourth day alboline was given in dram and later in half tablespoonful doses. This seemed effective for on the fifth day a small stool from the upper bowel was passed and contained a small quantity of alboline. A second stool containing a free admixture of alboline was passed. Altogether eleven ounces of alboline had been given. On the sixth day there developed a very sharp attack of abdominal pain, which lasted more than an hour. This was followed by accesses of vomiting. There also developed a marked distention of the abdomen and the temperature rose to 103. There were no further stools, nor was there discharge of any kind from the rectum.

Condition on Admission.—The patient presented the general appearance of suffering. He frequently cried out with pain. The temperature is 101.8, pulse 132. Abdomen is distended. The costal arches cannot be seen. On percussion there is general tympany with liver dulness somewhat pushed up. Although there is general muscular rigidity no special tenderness can be elicited. The examination is very unsatisfactory by reason of the child's resisting. Urinalysis negative.

Blood Examination.—White 15,800—polymorph. 53.11, small mononuclears 26.09, large mononuclears 20.09, eosinophiles 0.71.

An X-ray picture taken after the ingestion of a bismuth meal shows no intestinal occlusion, but a general gaseous distention. Digital examination of the rectum indicates some resistance on the left side of the pelvis, but it is not very distinct. Within the next two days the patient's condition did not improve. There was occasional vomiting of biliary matter, but no stool was passed. The blood count, October 23, was only 11,800 white. On October 24 it had risen to 22,000 and on the morning of the 25th to 33,000. At this time the rectal examination showed a distinct infiltration on the left side of the pelvis. It was then only that consent for an operation was obtained.

Provisional Diagnosis.—Appendicitis with left sided pelvic abscess.

Operation.—Jewish Hospital, October 25, 1912. Gas oxygen anæsthesia. When relaxation was obtained a very decided induration was observed for the first time in the left lower quadrant, wherefore, a pararectal incision was made on the left side.

On opening the peritoneum a slight amount of clear fluid escaped. The intestines were moderately distended. A mass on the left side contained the sigmoid with adherent overlying omentum. The latter was gently separated from the underlying intestine, whereby an abscess containing two or three ounces of very fetid pus was opened. The greater part of the purulent accumulation came from the left side of the pelvis. On widely retracting the wound margins and gently separating the omentum the entire sigmoid was exposed. For about three inches the walls were very much reddened, thickened and indurated. The entire mass was fixed on the iliac pan. The tineæ could not be made out, but a number of appendices were exposed. Except for these the surface of the sigmoid was uniform. There was no evidence of diverticulation. At the summit of the sigmoid loop there was a necrotic area as large as the little finger nail, which extended deeply into the intestinal wall. No effort was made, of course, to see whether it communicated with the intestinal lumen, although it seemed evident that rupture was imminent. The area was inverted, fixed with a few Lembert sutures and covered with omentum. The operation was completed by the insertion of a deep-seated cigarette drain. The post-operative course was rather a stormy one. Two days after the operation there were two bloody stools. The leucocytosis gradually subsided and with it the temperature. The latter, however, did not reach normal until the eleventh day. The patient left the hospital on the twenty-first day in practically normal condition.

A second case of suppurating perisigmoiditis in an infant was referred to me by Dr. Rachford.

Case II.—The patient, a female of nine months, had for several months suffered on and off from enterocolitis. It was a bottle-fed child. When brought to this city from its home in Lafayette, the patient was greatly emaciated and had evening temperature of 102. The stools frequent and small were occasionally blood-stained and there was always great rectal tenesmus. There had been no vomiting. The abdomen was slightly distended and in the lower left quadrant an indistinct swelling as large as a peach could be mapped out. It was very tender and seemingly fluctuating.

Operation.—Good Samaritan Annex, December 1, 1903, under chloroform anæsthesia, revealed no peritoneal involvement, but an abscess in the sigmoid-mesocolon. About three ounces of not fetid pus escaped. The abscess being well walled off the sigmoid was not looked for. Drainage was instituted and the patient made a slow but complete recovery.

The first of the above cases seems unique to me, for after a rather complete investigation of the literature of sigmoiditis I have found no similar case.[a] Giffin,[3] in a report of twenty-seven chronic cases, places the average age of diverticulitis at a little less than fifty-four years. Of one hundred and five cases of intestinal diverticulum cited by Telling[4] there was only one under forty years old. Hartwell,[5] it is true, conceded three cases occurring at the ages of seven years, six years and ten years respectively. The last two cases were obtained by autopsy. The diverticula were congenital and had nothing to do with the cause of death.

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[a] Since the above was written, I have come across a case reported by Goebel in a boy of three years in whom a secondary resection of the sigmoid loop was successfully made (Zentralbl. f. Chir., 1911, p. 211).

In the first case reported by Ashhurst,[6] the patient was operated upon and a mass found in the mesosigmoid. Ashhurst, himself, is in doubt as to the existence of a diverticulum in the mesenteric attachment of the gut as the primary cause of the swelling in the mesosigmoid. Therefore, he concedes that his diagnosis of mesosigmoiditis is conjectural. Another case of suppurating diverticulitis in a child which is often quoted is that of Walcha.[7] The patient, a ten-year-old girl, had passed a round worm two days before the onset of the symptoms. An abscess formed on the left side of the abdomen and the child died on the sixth day, evidently from peritonitis. There was no autopsy and there is no reason for believing that this was a case of diverticulitis.

It is probable that in the second case above reported we had to deal with a lymphangitis, which resulted in abscess from infection through an intact intestinal wall or a lymphadenitis from the same cause. When one considers the wealth of lymphatics in the intestinal wall and the frequency of infections of the intestinal mucosa, it is really remarkable that intramesenteric suppurations (of the nature of the case reported) are not more common.

If we except the doubtful case of Ashhurst as the only one operated on for diverticulitis in a child, there is no recorded case. In the two cases of sigmoid diverticulum discovered by autopsy in children by Hartwell, there were no clinical evidences of the condition. In an examination of five infants who had died from various infantile diseases Hartwell and Cecil found that in three there was some evidence of a weakness at one or more points. In each of the positive cases there occurred a slight outpushing of the wall of the intestine, which had somewhat the macroscopic appearance of the small diverticula seen in adults.

The examinations were made after the colons had been moderately hardened in formalin and then filled with water just sufficient to render the walls taut but not under enough pressure to stretch them.

These experiments appear to me inconclusive in view of the fact that no demonstrated case of acute diverticulitis in infancy or childhood has, to my knowledge, been recorded. Diverticula, it is true, may be almost microscopic and it is of course possible that such a diverticulum might have been the predisposing cause of the acuter symptoms which necessitated operation in Case I. In a very comprehensive and analytical article by Patel[8] he states, " Perhaps some day we will be enabled to state that almost all the cases described under the name of sigmoiditis are cases of diverticulitis, precisely as appendicitis little by little has been substituted for typhlitis." This inference does not seem to be justified for the one perhaps important reason, namely, that on the right side we *always* have the appendix and that on the left side the presence of a diverticulum can only be assumed until its presence is actually demonstrated by operation or autopsy.

The first case above reported seems to me conclusive that a primary inflammation may develop in the mucosa of the sigmoid, invade the deeper layers of the gut, and lead to necrosis and abscess formation without gross diverticulation as the basal factor.

In the second case there was no certainty even of the involvement of the sigmoid, although the previous history indicated some form of colic infection. In the classification of inflammatory lesions about the sigmoid based on an analysis of seventy cases, Patel classifies seventeen of them under the caption of non-suppurative sigmoiditis. All the cases recovered without operation, so that no evidence was obtained as to the exact anatomic changes which caused the tumor mass as one of the clinical symptoms. Most of these cases occurred in young subjects and only two of them were over forty. This is in marked contrast with the age history of acute or, for that matter, chronic diverticulitis which come to either operation or autopsy. The findings at operation in Case I so far as the induration, infiltration and fixation of the sigmoid are concerned were very much like those encountered in the case recently reported by Dowd.[9] Here, however, the inflammation involved the descending colon from the splenic flexure quite to the sigmoid. It was found to be red and hard and the walls so thickened that it seemed almost a solid mass and the consistency was nearer that of a garden hose than that of the normal intestine. The microscopic examination revealed great œdema with polynuclear cell infiltration of the mucosa with purulent exudate replacing the mucosa in most places. Had it been possible in Case I to obtain a section of the thickened sigmoid, I am quite certain that the picture would have been the counterpart of Dowd's case.

That sigmoiditis is a clearly defined morbid entity has been established since the articles published for Mayor,[10] Matthews,[11] Rosenheim[12] and Durant[13] in 1893, 1902, 1904, and 1911 respectively. The important factor of the diverticulum, of which the significance was later recognized, has threatened to overshadow the sigmoiditis unassociated therewith. Of course, the acute process when limited to the mucosa is often but a part of a colic infection of the sigmoid, but by reason of the position and function of the sigmoid, manifests itself there with greater severity. It may be necessary only to recall that here the fecal contents stagnate before their final expulsion and the time and opportunity for infection are perhaps greater than anywhere else, with the exception of the cæcum. That the effect in the long run is more baneful to the sigmoid is amply shown by the foreshadowing preponderance in the sigmoid of the chronic diverticulitis with its well-established train of symptoms.

Although two cases of left-sided lower quadrant intra-abdominal suppuration in children are scarcely enough to be statistically valuable, when considered with the hitherto published cases in adults, I think they justify me in tentatively submitting the following conclusions.

1. Although few cases of sigmoid diverticulation have been found in children, no case of diverticulitis has been recorded in a child.

2. To designate in a general way, as is the present tendency, all left-sided lower quadrant suppurations as of diverticular origin is not warranted by the facts. Unless a diverticulum is shown, the diagnosis must be problematical. This applies, of course, very much more to children than to adults in whom all the recorded cases have occurred.

3. Left-sided appendicitis cases have been described with and without visceral transposition.

4. It has not been my object to underrate the importance of the sigmoid diverticulum as the cause of left-sided abdominal suppurations, but to call attention to other conditions notably of the mucosa producing them and particularly in children.

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ON EXCISION OF THE INFARCT IN ACUTE HÆMATOGENOUS INFECTIONS OF THE KIDNEY.*

BY LUCIUS W. HOTCHKISS, M.D.,
OF NEW YORK,
Surgeon to Bellevue Hospital.

In recent years considerable attention has been directed to the study of acute hæmatogenous infection of the kidneys: The lesions which have been found are frequently unilateral, fairly characteristic, but by no means uniform in character or extent. Congestion, more or less intense and extensive, with œdema of the perirenal fat, infarctions, red and white, single and multiple, have all been described, singly or in combination. Brewer, who reported his first case in 1904, and later wrote extensively on the subject, has been a pioneer in calling the attention of the profession to the comparative frequency of its occurrence, as well as to the necessity of early diagnosis and radical surgery in the more severe cases.

A study of Brewer's cases, in his paper of 1906, most of which were of the severe septic type, with multiple scattered abscesses throughout the cortex, and with a clinical picture of profound sepsis, will show the wisdom of radical measures, viz: nephrectomy, in this variety.

The reports of Farrar Cobb, 1908, and later of Cotton, 1911, call attention to milder types of infection and the results from conservative measures.

A study of two very unusual cases of my own, which form the basis of this brief paper, reveals a type of acute unilateral septic infarct of the kidney wherein the lesions are discrete rather than scattered, and limited in both instances, to the upper pole and portion of the right and left kidney respectively.

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The diagnosis in these cases from the urinary findings was quite impossible, and the differential diagnosis in one of them from an empyema, was not easy.

In a fairly large experience in the surgery of the kidney I do not recall having met with a single instance of pathological conditions which resembled very closely the findings of the cases herein reported, nor at the time of operation was I cognizant of the fact that excision of the infarct had ever been attempted, and only learned of Woolsey's case in conversation with him long after my own experience.

In presenting these cases, I have no wish to submit any brief for the performance of this somewhat unique procedure of excision, but simply to present the facts of the cases in point and express the belief that in a somewhat restricted field, perhaps, the operation has a distinct place in that it is reasonably safe and fulfils the indications most admirably.

REPORT OF CASES.

Case I.—Louis K., twenty-three, single, admitted to the Greenwich Hospital, Feb. 21, 1909, to the service of Dr. Hyde, to whom I am indebted for the report and for much valuable assistance. His previous and personal history were entirely negligible as regards the present illness, which began three weeks ago with a sudden attack of pain in the right side which became worse and necessitated the calling in of a physician, who made a tentative diagnosis of appendicitis and gave him some medicine which relieved his pain. He suffered considerably from dysuria, however, which became worse, and finally, three days before he came to the hospital, complete retention of urine occurred, for which catheterization had been systematically done.

On admission his chief complaint was pain in the right side, and inability to pass his urine. His general condition was fairly good and he did not seem to be very sick. His temperature was 99.2°, pulse, 80, and he showed a white blood count of 12,000. The abdomen was scaphoid, tender over the bladder but no tenderness was noticed at this time, over the region of the kidney. There was a slight urethral discharge, thought to be due to use of the catheter, as he denied all venereal disease, and the smears were negative. A provisional diagnosis of acute cystitis, with a non-specific urethritis was made, and treatment with hot stupes locally and urotropin and catheterization, was instituted. An examination of the urine at this time showed a specific gravity of 1022, acid reaction, a trace of albumen, and many white and red blood and pus cells. Albumen was never demonstrated in any of the later specimens which were frequently examined, and the rest of the microscopic picture remained about the same, with the pus cells steadily diminishing as the cystitis improved. An examination of the urine for tubercle bacilli was negative.

For the first week, under regular catheterization, and irrigation of the bladder, with boric acid solution and argyrol, he improved steadily and began to void his urine naturally though with some pain.

On March 1 he complained of pain in the region of the right kidney which was increased on deep inspiration and was accompanied by tenderness along the lower right costal margin. This tenderness was most marked over the region of the gall-bladder, but there was no muscle spasm in this situation. There were no signs of pneumonia.

On March 8 as his temperature, which had been moderate, had suddenly shot up to 104.4° the day previous, and his white blood count had risen to about 14,000, with a polynuclear percentage of 80 per cent., I was asked to see him in consultation with Dr. Hyde, who had made a tentative diagnosis of kidney infection. At this time the tenderness over the bladder had entirely disappeared but there was extreme tenderness over the right kidney and extending forward to the middle line of the abdomen. As the case seemed to be one of probable renal suppuration and his condition was getting worse daily, an operation was advised.

Operation (March 12, 1909).—(Dr. Hotchkiss, with the assistance of Dr. Hyde and staff.) An oblique right lumbar incision exposed the kidney which was found to be adherent by its upper pole to the under surface of the right lobe of the liver, and when the somewhat dense adhesions were broken down, a perirenal abscess was opened in this situation which contained a moderate amount of pus, and was well encapsulated.

The kidney having been freed, it was pulled out of the wound and thoroughly examined. The cortex was split longitudinally and an abscess in the upper pole was opened and drained. There was found also a considerable triangular area of soft white infarction, apparently riddled with minute abscesses, and measuring about two inches across its base and not extending into the pelvis. As the rest of the organ appeared reasonably normal and the infarcted portion of the cortex was easily enucleable with the finger, the infarct which was not very adherent, was neatly extirpated in this manner with but very trifling bleeding, and the walls of the triangular gap in the kidney looked to be covered with granulations. The kidney was returned to its pocket and the gap in the cortex was pressed together by gauze pads introduced above and below the organ. These also provided for abundant drainage of the kidney and the wound, which was loosely closed to the drains.

There was free drainage of bloody fluid with a marked urinous odor for several days and the pads of gauze were removed and replaced by smaller ones on the fifth day. No blood appeared in the urine after the operation. About five days later, the gauze was removed and rubber tube drainage instituted, which had to be retained rather long on account of pus retention in the upper pocket following attempts at early removal. By April 13, however, the tubes were all removed, the wound was nearly closed and the patient sitting up and growing stronger daily. On April 30 he was discharged with a normal temperature, his wound healed, and apparently well.

Case II.—Peter K., twenty-three, car cleaner, Austrian, admitted to First Medical Division of Bellevue Hospital, service of Dr. Draper, Dec. 25, 1911. His family and personal history were negative. Married. No children. Denies syphilis and gonorrhœa.

Present illness began three weeks before admission with a sudden attack of pain, sharp and stabbing in character in the left side and only felt on deep inspiration and on coughing. Since onset the pain has been variable, at times almost none, sometimes very severe. One week before, his chest was strapped which relieved him very much. His appetite is poor, he sleeps fairly well, his bowels are regular.

Chief complaint, sharp pain in the left axilla. On examination, he did not appear to be acutely sick. His chest showed fairly good expansion, respirations were normal. There were a few fine râles at the extreme right base, and a few pleuritic râles at the base of the left axilla. Pulse regular and normal as to rate and force. The heart is negative. Abdomen, also negative.

Provisional diagnosis, pleurisy. Temperature on admission, 101°; pulse, 90; respirations, 24. Urine, cloudy, amber, 1029, alkaline, negative as to albumen, blood, bile, casts, pus, indican, and acetone, triple phosphates present. Aspiration of the chest on the day following, yielded no fluid.

Dec. 27: Temperature 102°; pulse 98; respirations 24; Widal, negative; white blood count 26,000; polynuclears 91 per cent.

Dec. 28: Sibilant and sonorous breathing and many fine râles at the left base. Aspiration at base of left lung, yields few drops of pus—a smear from which shows cocci; temperature 100.4° to 103.4°; pulse 72 to 90; respirations 22; white blood count 31,400; polynuclears 93 per cent.

Dec. 30: Temperature 100.6° to 104.6°; pulse 78 to 90; respirations 24; white blood count 26,400; polynuclears 90 per cent.

Dec. 31: Signs of fluid at the base of left lung, more marked, and pus found on aspiration.

January 18, 1912: Left chest aspirated between the eleventh and twelfth ribs, and 3 inches from spine, and 2 c.c. of fluid pus obtained.

Urinalysis.—Amber, slightly turbid, 1029, faintly alkaline, faint trace of albumen, occasional white blood cells and triple phosphates. Temperature 102°; pulse 100; respirations 24. Transferred to surgical side as case of empyema of lower left chest for operation.

In view of the history, the site at which pus had been obtained by aspiration, between the eleventh and twelfth ribs, a diagnosis of abscess below the diaphragm in relation with the left kidney was made by the writer.

Operation.—A vertical incision dividing the twelfth rib and prolonged downward over the left kidney was made and a small abscess was found below the diaphragm in close relation with the upper pole of the left kidney. The kidney was then pulled into the wound and examined. There was a good sized white infarct in the upper pole of the organ, which was riddled with small abscesses. Having in mind my former experience, and as the rest of the organ appeared uninvolved, the whole area including the infarct was easily enucleated with the finger and without any considerable bleeding as the walls of the gap in the kidney appeared to be granulating, and healthy. Two catgut sutures were introduced, bringing the sides of the gap loosely together. The kidney was dropped back into its bed and gauze drainage introduced and the wound partly closed.

Pathological report on the specimen of kidney tissue: "Large white infarct with small multiple abscesses."

Patient rallied well from the operation, saline given per rectum and on the morning following, five and one-half ounces of urine were voided. This was of brick red color, cloudy, and contained fine granular casts and many white and red blood cells. During the twenty-four hours 37 ounces were passed. Temperature, 100° to 102°; pulse 120; respirations 24.

January 4, 1912: Considerable discharge of bloody fluid from the wound.

January 10: Drains removed from the wound and replaced by smaller drains.

January 14: Wound is slowly granulating, but a small pocket below the diaphragm still discharges pus. Condition good, temperature falling below 100° in the morning, and convalescence well established.

January 28: The patient has been out of bed for past two days and is rapidly gaining. There is still some drainage from the small pocket beneath the diaphragm and the temperature has reached normal. The subsequent history is one of steady progress and recovery and discharge from the hospital in good condition on February 19, 1912.

THE TECHNIC OF NEPHRO-, PYELO- AND URETEROLITHOTOMY.

BY JOHN H. GIBBON, M.D.,

OF PHILADELPHIA.

I WAS first inclined to bring this subject before the Association because of my own interest in it but was later confirmed in my intention by discovering that only twice in the history of the Association have the different methods of removing stones from the kidney and ureter been a subject of consideration. It was in 1880, the year the American Surgical Association was founded, that Henry Morris first performed deliberately the removal of a stone from an otherwise healthy kidney. In 1895 there were three papers bearing on the subject read at the meeting in New York, that by Fenger on the "Surgery of the Ureter" being perhaps the most complete and satisfactory discussion that has ever been presented anywhere. The early work of Fenger and Cabot in renal and ureteral surgery must ever be a matter of pride with us. Again, in 1908, there were three papers presented (Bevan, McCosh, and Brewer) which produced a general discussion on renal surgery. At this time there was no unanimity of opinion regarding the best method of removing stones from the upper urinary tract but I believe to-day, in the light of improved diagnostic measures, satisfactory functional tests, perfected technic and greater experience, we may expect to find that there is a greater uniformity in our practice.

Nephrolithotomy and Pyelonephrotomy.—The life of nephrolithotomy corresponds to that of this Association as I have said, but for a number of years its tenure was a very doubtful one. As late as 1893, Ashhurst (*Principals and Practice of Surgery,* 1893), summarized the subject as follows: "The operation appears to have been performed in

130 cases, 12 times without finding any stone, and 30 times with a fatal result, while the issue in 5 cases has not been ascertained, leaving only 83 successes. Henry Morris is generally credited with and claims the first performance of this operation, though Ashhurst says " The first formal nephrotomy for the removal of renal calculus appears to have been performed by Marchetti, in the latter part of the seventeenth century." This however, if the case, does not detract from the credit due to Morris for his masterly work in this field and particularly for his earnest advocacy of nephrolithotomy before the kidney has been converted into a pus pocket.

The incision for the exposure of the kidney will probably never become uniform, nor is it necessary that it should. The straight incision along the edge of the erector spinæ with oblique extension along the iliac crest is the most generally employed. The upper portion of this incision near the twelfth rib must be made cautiously in order to avoid injury of the pleura which sometimes extends below the rib. Resection of the rib, especially when exposing the left kidney, makes the operation easier but I have never found it necessary. Mayo (ANNALS OF SURGERY, 1912, vol. lv) advises the free exposure of the twelfth rib and the division of the quadratus and the lateral arcuate ligament which bind the rib to the transverse process of the first lumbar vertebra and says that this procedure obviates the necessity of rib resection. I have lately followed this plan and find that it renders exposure and delivery of the kidney much easier. The injury of the pleura is not a serious one if promptly repaired. A more serious mistake is the division of and failure to suture the iliohypogastric and ilioinguinal nerves. These nerves should be exposed and drawn out of the way. Having opened up the fatty capsule and exposed the kidney, the hand should be introduced and the kidney and the upper ureter carefully palpated for stone. This should be done before the delivery of the kidney, as in the latter procedure the manipulations may cause a stone to be displaced and forced into the ureter. I believe that palpation is the best means we have for finding the stone. When carefully carried out I think it will demonstrate nearly any stone. Needling is a most unsatisfactory procedure and I think a dangerous one. I have removed a stone which needling failed to locate at a previous operation. If palpation fails to reveal a stone which is shown in an X-ray plate, the kidney or its pelvis should be opened and palpation carried out from within the organ. If the X-ray fails to show a stone and if palpation does not reveal it, I should not feel justified in opening up the kidney or the pelvis, unless I thought the symptoms were caused by some other condition which the further exploration might expose. A good X-ray plate of the entire urinary tract is essential to-day in the search for calculi and more and more do we depend upon it. It not only shows the location but the number of stones and, if a stereopticon plate, the relative position of the stones. The X-ray has done more than anything else to prevent extensive mutilation of kidneys in the search for stones. We hear less and less of cases where the plate showed no stone and yet one was found at operation. In delivering the kidney care must be taken not to injure it, tear its vessels, or tear the peritoneum. Better work and easier can be done with the kidney drawn entirely out of the wound and this should be one of the steps of the operation unless the dangers outweigh the advantages, as may be the case where there are extensive inflammatory adhesions. Having confirmed the X-ray findings and located the stone, the method of removal must be considered and here three procedures are open to us; each having its advantages in certain cases. They are the opening of the pelvis (pyelotomy), the formal splitting of the kidney a short distance back of its convex border where there are fewest vessels (Kelly), and direct incision immediately over the stone. In the early history of kidney surgery the incision into the pelvis for the removal of stone got a severe setback because it was apparently shown that persistent fistula was much more common than after nephrotomy. Even in 1908, at our last discussion of this subject, although Bevan in his paper advocated its performance where there was a choice, McCosh and others said they had tried it, but had gone back to nephrotomy as a safer operation. I believe to-day we will agree that pyelotomy is our preference except for the removal of large branching phosphatic stones and small ones lodged high up in the calices. Where the kidney is badly infected, nephrotomy may also be preferable. Henry Morris (*Surgical Diseases of the Kidney and Ureter,* 1901), who claims to have been the first to show that wounds in the kidney substance healed quicker and with less leakage than those in the pelvis, now says (1901) that with proper suturing this is not so. The incision in the pelvis is accompanied by less bleeding when properly done than that through the kidney, gives ample opportunity for exploration and, with improved technic, heals in the majority of cases without a leak or with very little leakage. The injury to the organ itself is far less than in nephrotomy. Care must be taken to incise and reflect the layer of fatty tissue covering the pelvis as shown by W. J. Mayo (*Surg., Gyn. and Obstet.,* April, 1910), and to carefully displace any vessels which may lie in the line of the proposed incision. The incision in the tissue overlying the pelvis should not be in the same line as that in the pelvis itself and the latter should be longitudinal and not extend quite up to the parenchyma.

In opening the kidney along its back as must be done in certain cases, the pedicle must be firmly compressed between the finger and the thumb of the operator's left hand and this compression kept up until the stones are removed and the wound closed by sutures. This is the best method of controlling the rather profuse bleeding which occurs when the kidney is opened. It is unnecessary and in fact futile to attempt ligation of the bleeding vessels in the kidney substance. Catgut sutures applied closely and not tied very tightly will always stop the bleeding and will not do any serious damage to the kidney. I have never used wire for opening the kidney as recommended by Cullen and Derge, nor the transverse incision of Marwedel. Compression of the pedicle by a rubber tube or by rubber-covered forceps may be necessary when the kidney cannot be delivered, but damage to the vessels by this method of compression is always possible. Care must always be exercised to avoid the breaking of a stone because if any particle is left it will surely increase in size and necessitate another operation or pass down into the ureter and perhaps not out through the urethra. Also every stone shown in the X-ray plate must, like sponges in the peritoneal cavity, be " removed or accounted for." Closure of the pelvic wounds should be neatly done with small catgut on a round needle and the fatty layer which was first reflexed now brought back and sutured in position. This layer will act much as the omentum does in intestinal work. Silk has no place in renal or ureteral surgery.

The third method of removal, and one which deserves more extensive use, is by incision directly over stones which are fixed in the kidney substance or high up in the calices. With the help of the X-rays this procedure is perfectly reliable for an extensive search of the entire interior of the kidney is no longer necessary. At the Pennsylvania Hospital last winter I removed seven stones from a kidney, the stereopticon plate (made by Doctor Bowen) showing each and their relative positions. I removed two stones from the pelvis, four from a pocket in the lower pole, and the seventh from one of the calices near the convex border, making three incisions, each directly over the stones. There was no urinary leakage whatever in this case and I am sure much less damage was done to the kidney by these three short incisions than would have accompanied the splitting of the entire kidney. In a number of other cases where the stone has been located by a good skiagraph, I have used this direct incision with the greatest satisfaction to myself and I believe with the least possible danger and discomfort to the patient. Binnie (*Operative Surgery,* 1911), approving of the plan, says: " It is far less damaging to the kidney to make several clean incisions through its parenchyma and thus extract the calculi with the minimum of laceration and contusion than to endeavor to take them all out through one cut. The latter plan too often results in the kidney's being converted into a ragged mass lying inside a nearly perfect capsule."

Our methods of drainage are now much simpler and much better than formerly when tubes and gauze were so freely used. The tube by pressure may do harm and should never enter the kidney or pelvic wound unless infection is very bad. The gauze drain resting against the line of suture by its capillary qualities invites leakage as has been learned by us all in intestinal and gall-bladder work. Even when it is desirable, because of pus, to drain the pelvis or kidney, a rubber-covered gauze drain is best. When no such indication is present, but the drain used as a precaution, folded rubber tissue or a small gauze wick enclosed in this material should be fixed at the site of the incision with a very small catgut suture and removed in four or five days or earlier. The fixation at the site desired is necessary as these soft rubber drains easily become displaced in the subsequent manipulations.

Ureterolithotomy.—I was surprised in looking up the history of this operation to find that Ricketts (*Surgery of the Ureters,* Cincinnati, 1908) and others credit Thomas, of Paris, with the first removal of a stone from the ureter in the year 1800, but on looking up the original article (*Recueil Period, de la Soc. de Med.,* 1800, viii, 216), I found that he had removed a mattress needle with incrustations from the *urethra.* Most of the early operations were done for stones lodged in the lower ureter and by the vaginal or rectal routes or else through the bladder. In 1884, Emmet operated successfully through the vagina; in 1887, Ceci removed a stone through the rectum; and in 1885, Cullingworth by the transperitoneal route. Bardenhauer, in 1882, did the first extraperitoneal operation. Other early operators following various routes were Cabot, Twynam, Ralfe, and Godlee, Hall, Fenger, Lane, Tuffier, and Roberts. I think we may say that the operation of removing stones from the ureter became established about 1890.

The operation differs materially with the situation of the stone. One of the common sites of lodgement is within an inch or two of the kidney pelvis and stones in this position should be dealt with through the usual lumbar incisions and removed at the point of lodgement or pushed up into the pelvis and removed as already described.

The next most common site for ureteral stones to become fixed is in that portion of the ureter which lies between the iliac vessels and the bladder in the male or broad ligament in the female. It is with stones in this situation that we have our greatest difficulty and about the removal of which we probably are most apt to differ. It must be understood that I am talking of stones which are too large or too rough to pass and not of stones which may be made to pass by drinking large quantities of water or by the injection of oil through the ureteral catheter. Where it appears that a stone is of a type that could be made to pass by these measures it is wrong to submit the patient to operation. In all cases which I have operated upon unless the operation was plainly indicated, the less severe measures have invariably been tried first. I believe, however, that we can delay operation too long in trying the simpler methods or in using them where they must appear futile at the start. I am sure too much manipulation with the ureteral instruments may do serious damage to the ureter, especially if the operator is not skilled and delicate in their use and we have all removed kidneys which have been destroyed by obstructing ureteral stones, which should have been extracted long before.

There are four routes of approach to a stone situated between the iliac vessels and the bladder or broad ligament; the sacral, the intraperitoneal, the extraperitoneal, and the combined intra- and extraperitoneal routes.

The sacral operation was first performed by Delbet (*Annals des Maladies des Organs Genito-Urinaires,* 1891, p. 2246), through a lateral incision extending along the coccyx and sacrum and was later improved by Cabot, who made an osteoplastic flap. Although Morris and others have employed this route successfully in a few cases it has never been and probably never will be generally used.

The intraperitoneal or transperitoneal removal of ureteral stones, although the easiest of all the methods, has quite obvious objections and can never be recommended as a perfectly safe procedure. John B. Roberts reported a successful transperitoneal ureterolithotomy before the Association in 1895 (*Transactions Americal Surgical Association,* 1895, xiii, 381). The ureter was sutured and covered with the peritoneum and there was no leakage or no infection. Lane, Kelly, and Desquin also reported early successful transperitoneal operations. Failures through leakage and infection have been reported however, and because of the likelihood of their occurrence this route can never be the one of choice. Still I believe that in certain cases it may be better to choose this method, which can be carried out with the minimum amount of traumatism to the ureter, rather than to pursue a more devious path through which one must work in the dark and do more damage to the ureter. I have never removed a stone through the peritoneal cavity but I can imagine circumstances under which it would be advisable. Bissell (*American Journal of Obstetrics,* 1908, lviii), presents a very strong argument in favor of the intraperitoneal operation especially in women and describes a very good technic. He reports a very successful case in which the wound in the ureter was covered by a peritoneal flap which had been reflected for its exposure and an extraperitoneal drain carried by blunt dissection from the ureteral wound down into the vagina. The operation has much to commend it and I shall feel inclined in a case where the stone is low down in the female ureter to employ it.

The extraperitoneal operation done usually through a muscle splitting incision parallel with Poupart's ligament and about an inch above its outer half or through the rectus sheath, is undoubtedly the ideal one but often its difficulties are such owing, first to the fact that when the peritoneum is dissected up the ureter remains adherent to it, as was first shown by Cabot, and second to the fixation of the stone so low down in the ureter as to render its exposure to sight nearly impossible. Given a fair sized stone lodged just below the iliac vessels this operation is comparatively easy. Fenger says that extraperitoneal ureterolithotomy had been done five times when his paper was written in 1894. In four cases the stone was above the iliac vessels, in three instances near the kidney and in but one case was the stone below the vessels. In this case Twynam located the stone by opening the abdomen, which was then closed, and the operator three weeks later removed the stone through an extraperitoneal incision in the iliac region. The technic of dealing with the ureter after the removal of the stone is considered in the description of the next method of operating.

The combined intra- and extraperitoneal operation has suggested itself to many operators but in the beginning the operation was often done in two stages, the stone being located through the peritoneal incision and later removed extraperitoneally. R. B. Hall (*Medical Record,* October 18, 1890) located a stone by exploratory laparotomy, forced it up into the kidney and removed it through a lumbar incision. The combined abdominal and lumbar operation for stone in kidney had, in 1892, been done ten times with but one death by Thornton (*Manual of Operative Surgery,* 1892). To T. C. Witherspoon (*New York Medical Journal,* May 21, 1904), I believe belongs the credit of doing the first combined operation for stone in the ureter. He explored the ureter from the peritoneal side through a rectus incision, located the stone, dissected up the peritoneum until the ureter was exposed, closed the peritoneum and removed the stone extraperitoneally. In 1905, Erdmann (ANNALS OF SURGERY, 1905, xliii) accidentally opened the peritoneum in doing an extraperitoneal operation and then intentionally enlarged the opening, confirmed the diagnosis, removed the appendix, and then extracted the stone extraperitoneally, while a finger in the peritoneum supported the ureter. In the same year I twice did much the same operation through a rectus (Kammerer) incision (ANNALS OF SURGERY, May, 1906). The operation was so easy as compared with the extraperitoneal method alone, that I have continued to use it wherever the stone cannot promptly be exposed in the extraperitoneal wound. In 1908, I reported (*Surg., Gyn., and Obstet.,* May, 1908) seven operations for ureteral calculus, in five of which a small opening was made in the peritoneum, which enabled me to at once locate the stone and by pressure bring it up into the extraperitoneal wound where it was removed; in the other two operations the stone was readily located and it was unnecessary to open the peritoneum. Since the publication of the paper in which the details of my first 6 cases (one had stones in both ureters, making 7 operations) are given, I have operated on 7 cases of ureteral stone, in 5 of which the combined operation was done. This makes a total of 14 operations with 10 combined intra- and extra-peritoneal ureterolithotomies. All the patients made good and prompt recoveries. Taking the 10 cases where the peritoneum was opened, there was no peritoneal infection and leakage of urine occurred but in 3 cases, the first two and the last. The ureteral wound was closed with sutures in but 2 cases. The leakage of urine is not dependent on sutures or lack of sutures but on the amount of traumatism which the ureter receives and the kind of drain which is used. I am sure that leakage in my first 2 cases resulted because of the presence of a gauze drain in close contact with the ureteral wound and, in the last case, was due to traumatism because I had considerable trouble in getting a very low-situated stone up into view and the ureter slipped away from the supporting finger in the peritoneum, necessitating a second incision in a very inaccessible portion of the ureter. The stone could never have been removed by the usual extraperitoneal operation. The drain should be of the type already described in connection with pyelotomy.

One of the advantages of the combined method, as practised in my own 10 operations, is the ability to explore thoroughly the entire ureter on the suspected side and a large part of the ureter on the opposite side. Another advantage is the fact that it is unnecessary for exploratory purposes to separate the ureter from its surroundings to any great extent and that damage to it through rough handling is not likely. The stone can also be much more readily passed up into a healthy portion of the ureter in the combined than in the simple extraperitoneal method. The one objection to this method which can be raised, is the possible infection of the peritoneal cavity. By the exercise of certain precautions I believe this can be reduced to practically nothing. My own rule has been not to open the ureter until the stone has been thoroughly exposed and the ureter fixed in the position desired for incision; and that when the forefinger has once been removed from the peritoneal cavity it is not again inserted. When the stone is removed the sutures, if needed, should be introduced at once and the drain passed down to the ureteral opening. The peritoneum is then closed and the drain brought out at a point as distant as possible from the peritoneal wound.

In certain cases it is difficult to locate the stone, and sometimes to find the ureter by the extraperitoneal route without extensive dissection and a prolonged operation. Attention is called to Case 6, of my first series in which two stones were removed from one ureter by the combined operation and one stone from the other ureter by the extraperitoneal route in thirty minutes; and this was not the result of a habit of operating hurriedly, but rather the result of the easy access to the ureter through the described incision. I do not wish to be understood as advocating the opening of the peritoneum in every case, nor have I practised this (10 times in 14 operations), but in doubtful or difficult cases I do believe that it is a measure which will greatly facilitate the operation, and reduce its complications, especially injury to the ureter. It is unnecessary to repeat the advantages to be derived from the ability to thoroughly explore the entire urinary tract through such an opening. In two of my recent cases I have had more trouble in getting the stone up into view than in any of the others but this was due to the fact that I was dealing with a stone very near the bladder and so fixed that it could not be pushed up the ureter without damage to this organ.

When the stone is situated in the vesical portion of the ureter in the male and in the vesical or broad ligament portion in the female, other methods than those already mentioned may be employed. The operating cystoscope has now largely supplanted the operation of opening the bladder to gain access to the stones. When the stone can be seen through the mouth of the ureter, the latter can be dilated and the stone extracted or oil injected above it. In the case of a large stone the ureteral mouth should be split until the stone can be removed. Bransford Lewis (*New York Medical Journal,* November 16, 1912), urges the use of the operating cystoscope even where the stone is fairly high in the ureter. He devotes considerable space to the dangers of ureterolithotomy and reports but one case where he has actually demonstrated the removal of a ureteral stone with ureteral instruments. The operating cystoscope is as useful as he implies but it too has its limitations and dangers.

In the female, stones which lie in the broad ligament portion of the ureter can be removed by direct incision through the vaginal wall or by the combined peritoneal and vaginal operation of Bissell, or by the Doyen (*Morris, Surgical Dispensary of Kidney and Ureter, London,* 1901, ii, 530), or the Garceau (*Jour. Amer. Med. Assoc.,* 1907, xlix), vaginal operations. Apparently urinary leakage is quite common after the vaginal operation and it is probably due to the incision being in the floor of the ureter.

RUPTURE OF THE BLADDER.*

WITH REPORT OF THREE UNUSUAL CASES.

BY GEORGE WOOLSEY, M.D.,
OF NEW YORK,
Surgeon to the Bellevue Hospital; Associate Surgeon to the Presbyterian Hospital.

Rupture of the bladder is not a common lesion, for that reason most cases have been and should be reported. Several excellent papers, including the statistics of reported cases, have been contributed, during the past ten years, by Alexander,[1] Jones[2] and others.

Most cases are either intra- or extraperitoneal. The latter is commonly associated with fracture of the pelvis, the former is the more common variety. Rarely there may be a combination of both.

Etiologically the lesion is usually due to an injury to a full bladder. A number of cases are recorded where it has occurred during distention for a suprapubic cystotomy, the rectum being at the same time distended by a Peterson bag. This distention is quite unnecessary if the patient is in the Trendelenburg position.

In a very few cases the bladder was not full at the time, but had just been emptied. In such cases great violence is required, and the rupture is extraperitoneal. Routh[3] reported the case of a drunken man, thirty-four years old, whose bladder was ruptured extraperitoneally by a kick in the abdomen one hour after voiding.

Again there may be no external injury. Such cases are called idiopathic ruptures, and usually depend upon some pathologic condition of the bladder associated with the presence of stone, stricture of the urethra or hypertrophy of the prostate. In a bladder thus weakened, and distended, violent muscular effort, especially violent attempts to empty the bladder, may cause its rupture.

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* Read before the American Surgical Association, May 8, 1913.

[1] Annals of Surgery, xxxv, 1902, p. 106.

[2] Annals of Surgery, xxxvii, 1903, p. 215.

[3] Brit. Med. Journ., Sept. 21, 1901, p. 811.

Apart from such predisposing conditions idiopathic rupture is rare.

The first case that I report was apparently an idiopathic rupture, without such predisposing conditions.

The patient, a single man, thirty-one years old, was alcoholic and on the previous evening, while bowling, was said to have drunk over a quart of champagne, besides beer. He said that he urinated at midnight and that at about 4 A.M. he was seized with a violent paroxysmal pain in the abdomen, which proved to be due to an intraperitoneal rupture of the bladder, low down on the posterior surface. When I saw him the next day the abdomen was much distended, rigid and tender. He had been twice catheterized and very bloody urine withdrawn. There were no history or signs of trauma, and he consistently denied having had any. The possibility of some trauma, which passed unnoticed on account of the effects of the alcohol, should be considered. But when he returned home, shortly after midnight, he had just voided, so that the supposition that he ran against the newel post, or some such thing, is not a likely explanation, as the bladder was not then distended. Moreover the pain did not come on until 4 A.M. The rupture probably occurred then for it is usually though not invariably followed at once by pain, and often by shock, in intraperitoneal ruptures. A few cases, however, are reported where the symptoms have been delayed for many hours or even days, and in patients under the influence of alcohol the shock may be lacking. Under the conditions present in this case we cannot arbitrarily assume that there was a trauma, but must admit that it was possibly an idiopathic rupture, due to rapid distention, on account of alcoholic excess.

As rupture may occur from violent muscular action of the bladder and the abdominal walls, we may admit the possibility of such a contributing cause, for the bladder wall felt and appeared healthy and distention alone in so short a time is not likely to have caused the rupture.

Frieberg[4] reports an intraperitoneal bladder rupture in a drunken man, from overdistention, without any known outward injury. Sugetinow[5] reports a case of intraperitoneal rupture of the bladder due to heavy lifting. The patient felt a sudden pain, and again on the fifth day, dying on the eighth day. Sugetinow believed that the mucous and muscular coats only gave way at first and the peritoneum on the fifth day. Jones[6] also reports the case of a man who, soon after urinating and defecating, had severe pain across the lower abdomen, with nausea and a desire to urinate. There was no trauma and an intraperitoneal rupture was found and closed. He was alcoholic. Bolton[7] reported a small rupture of the bladder in a man after two days intoxication. There was no history of injury and he woke up with pain in the abdomen. This patient was examined with the finger in the bladder, and no evidence of ulceration or any pathologic condition was found to account for rupture from overdistention.

It is well known that alcoholism predisposes to rupture of the bladder by causing its rapid distention and obtunding its sensitiveness, so that the call to urinate is disregarded. The muscles of the abdominal wall, which guard the bladder from injury, are also relaxed, so that a slight blow on the abdomen is sufficient to rupture the full bladder without leaving any sign of injury and without the patient being conscious of it. In any drunken patient the occurrence of some trauma can never be excluded.

In Case II the lack of any trauma is more definitely established. This patient was also alcoholic but not a drunkard. The case was obscure from the first, trauma was denied and there was no previous trouble with the bladder or urethra. While in perfect health, 6 days before he was seen by me, a man forty-two years old was taken with nausea and vomiting, and the next morning with pain and tenderness in the right lower quadrant. Urination was normal. As he had had two previous attacks of pain in the right lower quadrant, with vomiting, etc., the diagnosis of appendicitis was made. When seen by me he was very septic and weak, in wretched condition, stuporous, and hiccoughing continuously. The abdomen was distended and held quiet, and there was a large tender mass in the right lower quadrant. At the operation a very large quantity of ammoniacal purulent urine was found retroperitoneally, extending up behind the kidney and down into the pelvis. The appendix was normal. Subsequently the X-ray revealed no stone and tuberculin tests were negative, so that the usual causes of ulceration and perforation of the kidney pelvis and ureter were absent. Moreover, the urine remained alkaline and, for a time, the greater part of the total urine came from the incision, leaving only 5 to 8 ounces to be voided.

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[4] Virchow. Archiv., Bd. ccii, p. 268.

[5] Zblatt. f. Frankhtn. d. Hum. u. Sex Organ., 1900, p. 582.

[6] *Loc. cit.*

[7] Annals of Surgery, xxxvii, 1903, p. 438.

This pointed to a lesion of the bladder and on cystoscopy there was seen behind the right ureter mouth, a crevice extending laterally nearly across the bladder floor. It resembled a " healing scar, as if a rupture might have occurred here." In about three weeks the discharge of urine from the wound ceased, and a later cystoscopy showed the crevice left by the rupture, much shorter.

He made a slow convalescence and is now, two and a half years later, better than he has been for years.

These two cases are of interest in their bearing on the principle, emphasized by Naumann[8] and others, that a normal bladder never ruptures spontaneously, but that such a rupture depends upon pathologic changes in the bladder wall. In Case II we can not exclude the possibility of a pathologic bladder, in Case I, of some trauma. In the case of a man of fifty-five years, reported by Hosemann,[9] who was seized in the night with severe abdominal pain, operation revealed a small intraperitoneal rupture of the bladder. Trauma, drunkenness and overdistention were excluded, hence he assumes an abnormal or pathologic bladder, although such cases of rupture are rare. The operation and subsequent cystoscopy revealed nothing abnormal in the bladder.

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[8] Zblatt. f. Chir., 1911, p. 1344.

[9] Zblatt. f. Chir., 1912, p. 1323.

Rupture of the mucous and muscular layers, giving rise to a diverticulum covered by peritoneum, has been reported by Reid. In case of a previously formed diverticulum rupture of the weakened wall would require less force than is usually necessary to rupture the bladder.

In Case II the idea first to suggest itself is that there was a perforation of an ulcer, tuberculous or malignant, from within, so that it was a case of perforation rather than rupture. The cystoscope, however, failed to reveal any evidence of a diverticulum or of an ulceration, and there were no previous symptoms to suggest them. Alexander[10] has reported the case of a non-tuberculous abscess, following the psoas tendon, which ruptured into the bladder on the left side, and he had seen two cases of appendix abscess which opened into the bladder. According to Alexander the prognosis, in such cases, is good, except in tuberculous abscesses, and is much better when the rupture occurs from without in than in the opposite direction. In this case there was no symptom or sign of the rupture of an abscess into the bladder, no voiding of pus and no disturbance of micturition.

Speaking of spontaneous rupture from overdistention Gross says: " The mucous and muscular coats generally give way posteriorly, where the urine accumulates under the peritoneum as a kind of secondary pouch." And again the " urine may extend as high as the umbilicus and kidneys." Though we have in this case no good evidence of rupture from overdistention, the above description indicates the course the urine took.

The chief interest in Case III also concerns the etiology. There was here a history of trauma.

A man, thirty-six years old, while asleep on a fire escape, fell one story, landing on the buttocks and woke up with suprapubic pain and a desire to urinate. On operation an extraperitoneal rupture was found a little to the left of the middle line. There was no fracture of the pelvis.

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[10] *Loc. cit.*

Deaver,[11] has reported a case, also walking in his sleep, who fell two stories, landing on the buttocks, and had an extraperitoneal rupture of the bladder, without fracture of the pelvis.

Ashhurst[12] states that the rupture is sometimes caused by counterstroke, as by a fall on the buttocks. My patient drank two glasses of beer before going to sleep, and the bladder was full at the time of the fall. Whether the bladder is burst by the hydraulic pressure from within, which, when the fall is suddenly stopped, expands the bladder in planes at right angles to the vertical axis at the time of the fall, or whether a sudden muscular spasm is produced by the fall, is an open question. There was no direct blow on the bladder in this case, but the mechanism is much the same as in most of those where there is a direct blow over the bladder, without pelvic fracture, *i.e.*, an expanding of the bladder in one plane and a contraction or flattening in the plane at right angles to this.

Another interesting feature in this case was that though the principal rupture was apparently altogether extraperitoneal, there was considerable bloody fluid with a urinous odor in the peritoneal cavity. Also after an injection into the bladder, by the house surgeon, of 6 ounces of saline solution, of which only 3 ounces returned, the dulness, previously noted in the left flank and the left lower quadrant, was noticed to be shifting. On careful examination of the pelvis, in the Trendelenburg position, no intraperitoneal rupture of the bladder and no tear of the peritoneum could be found, though some fluid could be seen beneath the peritoneum. There was, however, what looked like a contusion, with ecchymosis beneath it, on the posterior surface of the bladder. On account of the fluid in the peritoneal cavity a drain was left in the rectovesical pouch, as well as in the prevesical space. The patient made a good recovery.

Kerr[13] reports a case of intraperitoneal rupture in which he was unable to find the rupture, though boric acid solution, injected into the bladder, was felt to well up in the bottom of the pelvis. Hence similar drainage was employed with a successful result.

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[11] ANNALS OF SURGERY, xxix, 1896, p. 751.

[12] ANNALS OF SURGERY, xxxiii, 1898, p. 385.

[13] ANNALS OF SURGERY, xxiii, 1893, p. 647.

Thorndike[14] reported six cases of rupture of the bladder, in two of which the opening could not be found. The wounds were drained and both patients recovered. In extraperitoneal ruptures failure to find the rupture is more common, and I know of such a condition in an unrecorded case.

In only one of the three cases was injection of a measured quantity of fluid used to confirm the diagnosis. When followed by operation without delay there is little danger. The fluid is sterile and so is the catheter. The danger lies in the carrying in of infection from the urethra in some cases. Hence the danger is about equally great in simple catheterization. In most cases the injection is unnecessary and in a few cases it has proved unreliable. Thus Bolton[15] reports a case where the small intraperitoneal opening was closed by fibrin, and all the fluid injected was returned by the catheter. Also Turnure[16] reports the case of a 3-inch intraperitoneal rupture in a drunken man, without history of trauma, where the fluid injected was all returned by catheter.

It has been demonstrated that sterile urine does not cause peritonitis. If the urine does not have a free outlet it is liable to become decomposed in time, giving rise to irritation. In several recorded cases the occurrence of peritonitis, or peritoneal irritation, has been delayed a number of days. This indicates that the bladder and its contents are sterile.

In most cases silk has been used to suture the bladder. When silk is used it is important to avoid passing it through the mucosa. This precaution is unnecessary when plain catgut is used. Chromic catgut is strong and durable enough for the muscularis. An additional peritoneal suture of silk or catgut should be added. The Trendelenburg position is of the greatest service in suturing ruptures on the posterior surface.

The bladder may be drained by a permanent catheter, or the patient may be catheterized frequently or made to void at short intervals. I prefer the permanent catheter for the first few days, unless it is contra-indicated by some infection of the urethra or bladder.

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[14] Journ. of Cutaneous and Genito-Urinary Diseases, May, 1899.

[15] *Loc. cit.*

[16] ANNALS OF SURGERY, vol. lvi, 1912, p. 807.

Two out of the three cases recovered. The only case of purely intraperitoneal rupture, a very alcoholic patient, died of delirium tremens and pneumonia on the fourth day after operation.

In 1907 Quick,[17] adding to previous statistics, found a mortality of 41.02 per cent. in 117 cases of intraperitoneal rupture of the bladder operated upon, or, since 1892, a mortality of 24.1 per cent. in 29 cases.

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[17] Annals of Surgery, xlx, 1907, p. 94.

SARCOMA OF THE STOMACH.*

BY CHARLES L. SCUDDER, M.D.,

OF BOSTON, MASS.

Surgeon to the Massachusetts General Hospital.

Sarcoma of the stomach is sufficiently rare to make it important that every case be reported. I report here one case of sarcoma growing from the posterior wall of the stomach. This patient entered the medical service of Dr. F. C. Shattuck, at the Massachusetts General Hospital with what was supposed to be symptoms of duodenal ulcer. His story, however, was atypical of ulcer. The long continued indigestion, the very great weakness and pallor of the man suggested that a hemorrhage had occurred from a duodenal ulcer. The man was so thin, feeble, pale, and ill, that it seemed wise not to institute surgical treatment at first. He did not improve, but continued to have hemorrhages from the bowel and to get progressively weaker. Finally, as a last resource, a jejunostomy was done.

When the abdomen was opened in order to perform a jejunostomy a correct diagnosis of tumor of the stomach wall, probably sarcoma, was made. The man improved so rapidly in strength and general condition that subsequently it was possible to do a partial gastrectomy. The very rapid improvement in this patient's condition following the latter operation was astonishing. His appetite returned, and he gained in weight and strength.

The patient has been seen during the past year and is known to be perfectly well. I hope to be able to make a further report of the later condition of this patient.

The employment of jejunostomy under such conditions of weakness as have been outlined above is to be advocated. There are cases of chronic ulcer and cases of carcinoma in which the employment of jejunostomy as a temporary measure is wise. Jejunostomy under these conditions may make a subsequent operation possible, when if a radical operation were attempted without the preliminary jejunostomy the patient might die.

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* Read by title at the annual meeting of the American Surgical Association, Washington, D. C., May, 1913.

I have collected all cases of sarcoma of the stomach in readily accessible literature which have been operated upon. In a study of these cases of sarcoma of the stomach certain facts are of interest. The tumor starts usually from the submucosa or muscularis. The mucosa is involved in the disease rather late. The disease is one of young and middle adult life. The posterior wall of the stomach and the greater curvature are most often involved. The orifices of the stomach, cardia, and pylorus are rarely involved. Various cell types of sarcoma are found. Spindle-cell sarcoma is quite common. The tumor may be small or reach even twelve pounds in weight. The growth is rarely secondary. It is ordinarily primary in the stomach. The growth extends either outward into the free abdominal cavity or into the lumen of the stomach as in the case here recorded. There is an absence of cachexia in far advanced cases of this disease; quite a different picture from that of carcinoma.

In the absence of metastases a radical operation appears to hold out even better chances of cure than in carcinoma.

I have appended the bibliography that has seemed to be pertinent to the subject under discussion.

CASE.—J. H. P., a Swede, aged twenty-nine years, occupation a composition floor-layer, entered the Massachusetts General Hospital on May 1, 1912. He was a private patient of Dr. W. W. Harvey, of Roxbury. His family history was excellent, his father, seven brothers, and one sister being alive and well. His mother was living but had some stomach trouble. The patient had always been strong and well excepting for an attack of typhoid fever "long ago." He chewed 35 cents' worth of tobacco a week. There was no history of venereal disease.

For about two years previous to the patient's entrance to the Hospital he had been troubled with frequent attacks of "indigestion" at irregular intervals, which were associated with constipation and slight, not disabling, pain in the right lower quadrant. After eating heavy food the pain increased and shifted to the epigastrium. He had no nausea or vomiting, but raised considerable gas. About four months ago, after an exposure to cold, an attack came on which persisted. There was vomiting every few days, the vomiting coming on from one to four hours after meals, and relieving the pain for several hours. He had never tried soda for the relief of pain. The pain was not colicky or burning, and was never severe. His appetite was fair, and he was able to eat meat, eggs, milk, and gruels, but no heavy foods. His bowels were constipated, but moved daily with castor oil, salts, or enemas. He had grown steadily weaker and had done no work for three months. The last week previous to his entrance to the Hospital he had been in bed because of weakness. The night before his entrance he was taken for the first time with hot, burning pain in the epigastrium after eating rhubarb for supper. He got to sleep about midnight, but was awakened about 4 o'clock in the morning with more of the same pain and vomited about a pint of brown fluid which his doctor said was blood.

The patient had eaten nothing on the morning after the attack, and had not had much pain, but felt weaker than ever. He was not troubled with coughs, headaches, dyspnœa or œdema. A complete physical examination was not attempted, but a superficial examination showed nothing abnormal.

Blood smear: Slight achromia with polynuclear leucocytes.

May 1. White blood corpuscles, 16,000; hæmoglobin, 80 per cent.

May 5. White blood corpuscles, 14,000; hæmoglobin, 80 per cent.

May 10. White blood corpuscles, 16,000; hæmoglobin, 75 per cent.; red blood corpuscles, 4,580,000.

The patient was given nothing by mouth or rectum for two days, and then was put on rectal feeding for three days. During this time he complained of attacks of burning and cramps in the epigastrium which kept him awake at night. The first few days these attacks sometimes terminated in vomiting large amounts of fluid with "coffee grounds" material. The guaiac test for the stool was repeatedly strongly positive.

On the sixth day he was put on first stage gastric ulcer diet and kept on this diet for three days. Each day early in the evening he had an attack of pain and vomited one-third of a basin full of milk, mucus and crackers, almost all he had taken during the day. On the ninth day he was given milk and crackers every half hour, but vomited as before. Visible peristalsis was noted in the right epigastrium. A diagnosis of obstruction at the pylorus was made and an immediate exploratory operation was advised.

At the operation on May 10, a sarcomatous tumor, the size of a closed fist, was found on the posterior wall of the stomach projecting into the stomach cavity. The tumor was rather discrete and showed no thickening about it. There were no definite glands. A jejunostomy was done.

The patient recovered well from the operation and grew stronger, but still vomited frequently at night. On June 25, he was still doing well and had gained sufficient strength to permit of the removal of the tumor.

On June 26, a second operation was done, a partial gastrectomy for the removal of the tumor of the stomach, the jejunostomy being untouched. On June 29, the jejunostomy was disconnected, the jejunal fistula closed, and an anterior gastro-enterostomy was done at a point a little distal to the situation of the jejunal opening. Following this operation the patient made an excellent recovery. There was no vomiting and the wound healed rapidly. He was discharged from the Hospital on July 26, 1912.

In December, 1912, the patient reported for examination and appeared to be in perfect health. He weighed 160 pounds, having gained 70 pounds since he left the hospital. He was working regularly as a composition floor-layer eight hours a day. On April 1, 1913, he was reported to be perfectly well.

The pathological report upon the tumor removed on June 26 was as follows:

> " Specimen consists of a solid tumor of the stomach, circular, and resembling a doughnut in shape, measuring 4 and 6 cm., with its centre filled with a polypoid mass projecting above the periphery of the tumor. Its surface is smooth, and on section it is grayish white and homogeneous, with spots which are yellowish. There is a wide margin of gastric wall at one end while at the other the free mucous surface is only 5 to 6 cm.

CASES OF SARCOMA OF THE STOMACH OPERATED UPON.

Name.	No.	Sex.	Age.	Kind of sarcoma.	Location in stomach.	Remarks.	Reference.
Capello	1	F.	54	Cystic	....	Well two years later	Centralbl. f. Chir., 1899, No. 20, p. 609.
Cantwell	2	F.	52	Spindle-cell	Posterior wall	Well eight months. Recurrence	ANNALS OF SURGERY, November, 1899, p. 596.
Billroth	3	..	..	Round-cell	Anterior wall	....	Wien. med. Presse, 1888, Nos. 4 and 5.
Dock	4	M.	55	Lymphosarcoma	....	Partial gastrectomy	Journal of the American Medical Association, 1900, xxxv, 156.
Hartley	5	F.	54	Spindle-cell	Posterior wall	....	ANNALS OF SURGERY, 1896, i, 609.
Schopf	6	F.	..	Lymphosarcoma	....	Well one year. Gastrectomy	Centralbl. f. Chir., 1899, xx, 609.
Moschcowitz	7	M.	50	Lymphosarcoma	Near pylorus	Well nine months	ANNALS OF SURGERY, 1912, lv.
Yates-Ochsner	8	F.	57	Large round-cell	Posterior wall	....	ANNALS OF SURGERY, 1906, xliv, 599.
Yates-Ochsner	9	M.	44	Spindle-cell	Posterior wall	Well four and one-half months.	
MacCormick	10	F.	53	Spindle-cell	Posterior wall	Well five months	Scotland Medical Journal, 1906, p. 299.
MacCormick	11	M.	62	Spindle-cell	Posterior wall	Well two months. Partial gastrectomy.	
Bird	12	..	..	Spindle-cell	....	Lived three years and four months	Intercol. Med. Jour., 1903, p. 78.
Török (Salaman)	13	F.	21	Round-cell	....	....	Transactions Pathological Society, London, 1904.
Morton	14	M.	39	Round-cell	Diffuse	Well two years	British Medical Journal, 1899 and 1901.
Miodowski	15	F.	40	Large round-cell	Posterior wall	Died	Virchow's Arch., 1903, p. 156.
Herman	16	F.	60	Myxofibroma	Great curv.	....	Transactions of the obstetrical Society, 1901, vol. xliii.
Alessandri (Salaman)	17	F.	53	Fibrosarcoma	Great curv.	....	Mitt. a. d. Grengzeb. d. Med. u. Chir., Band xii, Heft 4.
v. Eiselsberg (Moser)	18	..	..	Fibrosarcoma	Fundus	....	Deutsch. med. Woch., 1903, pp. 133 and 157.
Moser	19	F.	41	Myxosarcoma	Posterior wall	....	Deutsch. med. Woch., 1903, pp. 133 and 157.
Moser	20	F.	17	Myxosarcoma	Lesser curv.	Died.	ANNALS OF SURGERY, 1910, vol. lii.
Mayland and Anderson	21	F.	57	Spindle-cell	Great curv.	Well	

" Microscopical examination of sections removed from various portions shows a normal gastric mucosa with tumor lying immediately below. The tumor is composed of elongated spindle-cells and has numerous blood-vessels. In the midst of these long spindle-cells there are numerous eosinophiles. It seems probable that the cells are derived from the smooth muscular fibres.

" Diagnosis: Spindle-cell sarcoma.

" H. F. HARTWELL."

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Dickinson: Jour. Amer. Med. Assoc., 1909, liii, 117.
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THE SURGICAL ASPECTS OF PURPURA.*

BY JAMES F. MITCHELL, M.D.,

OF WASHINGTON, D. C.

In the consideration of factors of safety in surgical operations, hemorrhagic tendency on the part of the patient deserves a place of high importance. This tendency may be inherited, natural or acquired; the three chief groups into which pathological hemorrhages fall being hæmophilia, purpuric conditions and those associated with obstructions of the bile ducts.

Hæmophilia is defined as a strange anomaly characterized by often uncontrollable bleeding. The condition may be acquired but is usually congenital. It has been said to be the most hereditary of the hereditary diseases and we are all familiar with those bleeder families in which the tendency can be traced for generations. The mode of transmission and the pathology are both interesting; but the chief surgical importance lies in the fact that in the presence of such a history even the slightest operations should be strictly avoided. When an operation upon such an individual becomes imperative, it should be undertaken only with a thorough understanding of its dangers and after the institution of every possible precaution against bleeding. Among such precautions may be considered the pre-operative administration of calcium salts and foreign serum, painstaking hæmostasis and accurate coaptation of tissues during the operation and firm pressure with careful bandaging after the operation.

In icteric conditions practically the same advice may be given; for death may result from uncontrollable oozing where no vessel of any size can be detected.

Purpura, on the other hand, offers a greater surgical interest because of its many variations, the widely different symptoms which it presents, the possibility of confusion in diagnosis and certain complications which may demand operation. The term purpura was first applied by the ancients to the eruptions of scarlet fever and measles as well as to hemorrhage into the skin; but has been restricted to spontaneous hemorrhages in the skin and mucous membranes. It represents both a symptom and a disease, and has been referred to by Osler as "That obscure and interesting manifestation of which we know so much and at the same time so little." In distinction from hæmophilia the hemorrhagic tendency is acquired and usually transitory.

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* Read before the American Surgical Association, May 8, 1913.

As a symptom, purpura may appear in hæmophilia or in scurvy, the three conditions thus in many ways bearing a resemblance. It may occur in any infectious disease and in many other conditions. As a result of the administration of certain drugs, in nervous conditions and from mechanical strain, the eruption is sometimes seen.

A recent case seen in consultation with Doctors Behrend and Reede, which serves as a stimulus for this report, is an example of symptomatic purpura.

Case I.—A strong, healthy girl, aged fourteen years, nine days ago began to limp and complain of pain in the right hip. The following day she felt chilly, but on the next was able to go to school. On the fifth day of her illness she was seen by Dr. Reede, who found her temperature 103°, marked tenderness in the right iliac fossa, sensitiveness over the whole abdomen and looseness of the bowels. On the sixth day she was brought to the hospital and has remained in about the same condition. Because of the possibility of deep-seated bone infection a surgical opinion was desired. Her temperature when seen at the hospital was 104°, leucocytes, 13,300. Examination of the chest and abdomen was negative except for abdominal tenderness. "Over the great trochanter of the right femur is an area about 6 cm. in diameter, distinctly hemorrhagic, dark purple in color, with a surrounding margin of œdema about 1 cm. wide. This area is slightly tender, elevated above the general level of the skin and is entirely limited to the skin, which can be moved over the underlying structures. No other purpuric spots are to be found." After this her temperature gradually subsided and was normal for a few days. It then rose again and a definite Widal reaction was obtained by Dr. Russell. She ran a mild course of typhoid fever. The hemorrhagic area sloughed through the thickness of the skin and healed by granulation.

Gangrene in purpuric areas is rare but may occur, as in a case reported by Prentiss, in which a portion of the anterior abdominal wall, the site of hemorrhage, sloughed away. And in Lett's case there was sloughing of purpuric areas on the face, scrotum and other parts.

It is maintained by some that there is no such thing as the disease, purpura, or in other words that it is always a symptom. Nevertheless several forms of the disease are generally recognized, exhibiting different grades of intensity; but all characterized by the special feature of spontaneous hemorrhage into the skin or mucous membranes. There is also close association with urticaria, erythema and angioneurotic œdema; Osler describing them collectively as the erythema group of skin diseases. The cause of the disease is unknown, nor has it been decided whether the primary change is in the blood-vessels or in the blood itself. Infectious origin has also been claimed. Post-mortem examinations have shown hemorrhages into the mucous membranes and other regions, but nothing to throw any light on the intrinsic cause. The characteristic lesion is hemorrhage into the skin, varying in size, usually round and sometimes covering large areas through the confluence of several hemorrhages. The fresh spots are bright red but soon become purple in color and do not disappear on pressure. The color gradually changes as in an ordinary bruise and finally disappears, leaving no trace. The eruption is more common on the extremities, particularly the legs, and is more marked on the extensor surfaces. When combined with œdema the patches are elevated.

Without attempting to go into etiology or classification, it suffices to state that one variety, known as Henoch's purpura, is most interesting from a surgical standpoint. Attention was first called to this form by Henoch in 1874, though a case had been previously reported. It is characterized by recurrent attacks of purpura and crises of abdominal pain, often accompanied by vomiting and diarrhœa and with arthritic pain and swelling. It is relatively more common in childhood, but may occur in adults. It may begin with rheumatic pains and swelling of the joints and be followed by purpura and colic with vomiting and blood in the stools; or gastro-intestinal symptoms may appear first and purpura and joint conditions follow. Recurrence is characteristic. Fever is usually mild and there is ordinarily a slight leucocytosis. Epistaxis, hæmaturia, and hæmoptysis often occur. The purpuric rash usually comes after the other symptoms and is often unnoticed. The abdominal symptoms having once appeared usually dominate the scene. The pain is colicky in character; does not yield to treatment, and may continue for a number of days. The colic is intense. The abdomen is usually rigid and tender. In the beginning the tenderness is diffuse; but may become localized over some particular area, usually the right lower abdomen, thus suggesting appendicitis. Vomiting is often distressing and constipation stubborn, suggesting intestinal obstruction. The prognosis is ordinarily good, although Pratt reports eight deaths in a combined series of 202 cases. The explanation of the abdominal symptoms, on the basis of autopsy data, is not clear. In view of the findings of Lennander, as to the insensibility of the abdominal viscera and the extreme sensitiveness of the parietal peritoneum, it is clear that simple hemorrhage into the mucous membranes or localized œdema of the intestines would not be a satisfactory explanation, unless these changes should be sufficient to offer an obstruction to the fecal current. With such an obstruction present the explanation would be simple, for we would then have the same dragging on the parietal peritoneum through the mesentery as occurs in obstructions from kinks, bands, adhesions, etc.

The importance of the condition, surgically, then lies in the fact that the abdominal symptoms may be so striking as to lead one to open the abdomen, and Pratt states that the literature shows at least six patients who have been subjected to an exploratory laparotomy under this illusion. Quoting Osler, he states that " in children with colic the greatest care should be taken to get a full history which may bring out previous attacks either of skin lesions, of arthritis, or of intestinal crises; and secondly to make a most careful inspection of the skin for angioneurotic œdema, purpura, or erythema," and says that " with the exception of one case in which intussusception was found at autopsy, recovery from the colic has occurred in every instance." Osler himself goes further in saying that " it is also to be borne in mind that recurring colic may be for many years the sole feature of this remarkable disease. The colic is the most constant of the visceral manifestations occurring in 25 of my 29 cases. So far as I know it is never dangerous. In no case has death resulted, I believe, from intestinal causes."

I have personally seen several cases in which the diagnosis has been confusing and one in which an actual laparotomy was done under the diagnosis of appendicitis.

Case II.—On March 28, 1899, a little girl, aged seven years, was sent into Johns Hopkins Hospital by an excellent physician, with a diagnosis of appendicitis with spreading peritonitis. Two weeks before she had been successfully vaccinated, since which time she had been indisposed with enlargement of the axillary glands, slight fever and loss of appetite. On Friday last, to-day being Tuesday, the left leg became swollen and painful from the knee to the ankle. This subsided in twenty-four hours. On Saturday morning she complained of intense pain in the abdomen about the navel, more on the right side than on the left. There was vomiting from Saturday until to-day. The vomitus was foul and on one occasion dark as if containing blood. The urine was negative. The bowels moved Saturday with salts and have moved since with no trace of blood. There has been fever and rapid pulse. Examination at the time of admission showed the temperature 100.2° ; pulse, 126; respiration, 33; leucocytes, 25,000; face flushed; tongue clean; abdomen slightly distended and rigid, but abdominal respiratory movements present. There was slight abdominal tenderness, more marked on the right side, but deep palpation was everywhere possible and there was no mass, no dulness and no actual spasm. Over both knees and elbows were numerous purpuric spots varying in size from pin points to 1 cm. in diameter.

The mother of the child gave a history of a similar attack a year ago in which both knee-joints were swollen and painful and said that the child had always been inclined to abdominal trouble; but did not remember any spots until this attack. A diagnosis of Henoch's purpura was made and the condition cleared up in a few days.

It is quite evident that in this case, except for the fact that a thorough examination and a complete history revealed the presence of purpuric spots and the previous occurrence of a similar attack, an operation might have been undertaken.

Osler describes a second similar case admitted a year or so later in the same way. Lichty and Donaldson record two more quite identical ones and another has occurred in my own service.

Case III.—In 1907, a colored boy, aged about fourteen years, was sent into my service at Providence Hospital with a diagnosis of acute appendicitis. There was a history of two or three days' illness, with slight fever, vomiting and intense abdominal colic, the pain and tenderness being most severe in the region of the appendix. In the examination of the boy there was found a general purpuric eruption over both legs and a diagnosis of purpura was made. No operation was done and a rapid recovery followed. The patient remained in the Hospital as an elevator boy for a year and had no recurrence of the trouble. He gave an old history of rheumatism and there is no doubt that an examination of his legs at the time of his rheumatic attacks would have revealed the presence of purpuric spots and that the case was undoubtedly a true Henoch's purpura.

By permission of Dr. Harrison Crook I am enabled to record a case in which the appendix was removed.

Case IV.—A boy, aged twelve years, was admitted to Providence Hospital in the service of Dr. Crook in 1905. He had been ill for a couple of days with acute abdominal colic, slight fever and vomiting. There was general abdominal tenderness and rigidity, most marked however in the right iliac region. The symptoms were so suggestive of a mild appendicular attack that Dr. Crook operated and through a McBurney incision removed the appendix. I saw the boy in consultation three days later, Dr. Crook stating that his colic had not been relieved by the operation and that the findings in the appendix at operation did not seem enough to explain his symptoms. "At operation the appendix was congested and its superficial vessels distended. Inspection of the last two feet of the ileum showed that it also presented the same appearance and that the Peyer's patches all seemed enlarged, dark in color and projecting from the surface of the bowel, much resembling the condition seen in typhoid fever." There was no recollection of actual hemorrhage into the peritoneum or viscera, although the whole peritoneum was congested. Examination at this time showed slight abdominal distention with no actual spasm and no sign of peritonitis. The legs were covered with purpuric spots, especially marked on the extensor surfaces, all of small size. There were no spots on the arms or trunk and there was no joint tenderness. A diagnosis of Henoch's purpura was made and the condition cleared up rapidly.

In this case the most striking abdominal finding was the appearance of the lower ileum, and it seems quite possible that, with such a hemorrhage or œdematous condition of the Peyer's patches, there may have been at some point enough swelling of the bowel wall to cause a local paralysis which is equivalent to a local obstruction. With such an obstruction the increased peristalsis of the intestines endeavoring to overcome it would be quite sufficient to cause colic by dragging on the mesentery. Jacobsen had a similar instance in which a hemorrhagic appendix was removed.

During the last two years I have had under observation at intervals a most striking case, which I cannot class as a true Henoch's purpura, but it is certainly a closely allied condition; and on several occasions the symptoms have been so alarming as to suggest the possibility of operative interference.

Case V.—A girl, aged five years, was seen in consultation with Dr. Blair Spencer in November, 1910. There was a history of abdominal disturbances beginning shortly after birth and at the age of two years there was vomiting of blood. In August, 1909, she had an acute illness with temperature 103°, great abdominal pain and intestinal hemorrhages for several days. She had another attack similar to this in September, 1909, when she was operated upon by another surgeon. No abdominal findings were recorded except "general intestinal distention." After this operation she came under the care of Dr. Spencer and, with careful dieting and hygiene, her condition improved and for a year she was quite well. Again in November, 1910, she had an attack in which bright blood was vomited and she was brought into the hospital. She was in a state of collapse; temperature, 96°; pulse practically uncountable. With the administration of horse serum there was complete cessation of hemorrhage and the child rapidly regained its normal health. Since this time she has had one or two similar, though milder, attacks characterized by vomiting of bright blood and bright blood in the stools. With each of these attacks there have been purpuric spots on the limbs, intense abdominal pain and pains in the joints. In each instance an injection of horse serum has served to check the hemorrhage. During the past year she has been given periodic small doses of the serum and has been free from trouble and is now well nourished and apparently in excellent health.

A review of the recent literature would lead one to take a rather more serious view of the visceral complications than that suggested by Osler and Pratt; for, in addition to those cases which at operation have revealed nothing for which operation was demanded, there are many in which operation was necessary and others in which death has occurred from intra-abdominal causes with and without operation. In looking over these cases one is struck by the fact that the chief seat of the lesions is the ileum, especially its lower portion in the neighborhood of the ileocæcal valve. All grades of lesions can be traced from simple hemorrhage or œdema to intussusception, grangrene, perforation, peritonitis and death; and from the data obtained on the operating table a clear picture of the pathology can be drawn and the abdominal symptoms readily explained. In the cases of Crook and Burrow there was nothing more than congestion with localized small hemorrhages in the lower portion of the ileum. In the case of Harrington there was a definite ring of œdema in the lower portion of the ileum, causing a local paralysis equivalent to a local obstruction. We can thus readily explain the paroxysmal abdominal pain caused by the intestine attempting to overcome this obstruction and dragging on its mesentery with each contraction. Cook and Mills both saw several similar œdematous rings at intervals along the ileum. Greig suspected intussusception in his case and felt a tumor before operation, but when the abdomen was opened and the tumor delivered it proved to be a great congestion of the lower end of the ileum projecting, as a collar, into the cæcum without obliteration of the lumen.

Intussusception is by far the most frequent and most serious intestinal complication and each step in its production can be seen in the various lesions described in operative reports. It is most often ileocæcal or may be enteric. Numerous cases have been treated by operation either by reduction or resection and Vierhuff reports an instance of one which sloughed and was passed per anum, the patient recovering. Sutherland describes one case operated on for a supposed intussusception and a second in which an unsuspected ileocæcal invagination became gangrenous and its perforation resulted in peritonitis and death.

Nobécourt reports one instance of perforation of the duodenum 15 cm. from the pylorus and Silberman a death from gastric perforation. Aside from these two isolated accidents, lesions seem to be pretty constantly confined to the lower ileum.

In a by-no-means exhaustive review of the literature, I find 19 instances in which laparotomy was performed. Eleven times nothing was found which demanded operation and in the majority of these intussusception was suspected; 9 of these recovered, 1 died in eight hours, one later of pneumonia and a third in three weeks of nephritis. In 8 cases intussusception was demonstrated at operation, 4 being treated by resection and 4 by reduction, with 3 recoveries by each method. Three were unoperated with 1 recovery, making 11 actual cases of intussusception.

In regard to treatment two points are suggested: (1) the efficacy of injections of serum, and (2) the diminution of peristalsis for the relief of abdominal colic and the possible prevention of intussusception.

In the administration of foreign serum we have a valuable aid in the treatment of hemorrhagic tendency. Human serum is to be preferred; but fresh rabbit or horse serum may be used and in the absence of these the ordinary diphtheria antitoxin will suffice. In Case V of my series, small doses (10 to 15 c.c.) of normal horse serum served to check the hemorrhage during an attack, and under periodic doses no further attacks have occurred. In several hemorrhages of the newborn it has seemed to act as a specific. Successful treatment of purpuric conditions with human serum has been reported by Luton, Wilson, and others.

It is interesting to note from the operative reports that in the majority of instances there is not absolute occlusion of the bowel; also that the intussusception is undoubtedly caused by a primary area of œdema or hemorrhage, usually in the lower ileum, acting as a definite obstruction.

In the presence of abdominal crises we can therefore assume the existence of such an area. By keeping the intestinal tract empty through starvation and gastric lavage and by further lessening peristalsis with small doses of opium, the colic may be controlled and the possibility of the commonest and most serious abdominal complication, viz., intussusception, may be greatly lessened. In case of grave suspicion as to the nature of the abdominal condition an exploratory laparotomy is not greatly to be feared; for of the 12 cases unnecessarily operated on there was only one death which could be attributed to the operation. The recovery rate where intussusception was found—8 cases with 6 recoveries—is as good as occurs with intussusception from other conditions.

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ANEURISM OF THE INTERNAL ILIAC.*

PROBABLY IMMEDIATELY FOLLOWING A SEVERE INSTRUMENTAL DELIVERY: OPERATION AND PARTIAL CURE.

BY ARCHIBALD MacLAREN, M.D.,

OF ST. PAUL, MINN.

It seems that such a rare condition as an aneurism of the internal iliac should be reported. Matas, in *Keen's Surgery,* in reviewing the general subject of aneurism reports several thousands from the literature and does not give a single instance of internal iliac aneurism. Ericson in a large number reports a single case.

Aneurism is a disease of middle life. R. W. Parker quoted by Eve, in *Park's Surgery,* from a study of the literature only found 15 cases of any form of aneurism under twenty years of age. McGraw in *Transactions of the American Surgical Association,* of 1909, reports 64 cases in young people, compiled from the Surgeon-General's Office.

Case Report.—Mrs. J. J. F., first came under observation, October 4, 1911, with a pulsating tumor in the left pelvis about the size of a tennis ball.

Previous History.—Always well until twelve years of age, when she had what was supposed to be an attack of rheumatism, lasting six weeks, but as it left her with a permanently atrophied left leg, the trouble was probably infantile paralysis; she had a marked sensation of pulsation in her left hip at this time, which slowly disappeared. She commenced to menstruate at fourteen years of age, flowing normally about three days, with twenty-eight days intervals. When a little over seventeen years of age she was married. She promptly conceived and had a normal puerperium. In March of 1911, she was confined. Her labor was very difficult and lasted seventy-two hours, being terminated by a difficult forceps delivery. On the third or fourth day after her delivery she commenced to have severe pain in the left partially paralyzed limb, extending from the left hip down into the leg—worse in the calf and ankle; she also had marked distress in the rectum. Her temperature and pulse were normal. She was able to get out of bed on the ninth day. About six weeks after her confinement, she had severe pain and a sense of pressure in the lower left pelvis, which was increased by walking or being on her feet for any length of time. About this time she noticed a sense of pulsation in the region of her left hip. The pelvic distress and pulsation steadily increased in spite of local treatment up to the time of her operation.

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*Read before the American Surgical Association, May 8, 1913.

Physical Examination.—A well-nourished young woman, aged eighteen years; five feet in height; weight 130 pounds; abdomen and chest normal; atrophied left leg, all muscles weak, but able to walk with a dragging limp. Her reflexes were otherwise normal; Wassermann negative; examination of urine and blood normal. Pelvic examination showed laceration of cervix; uterus normal in size, motility and position, except that it was pushed to the right side of the pelvis by a hard tumor in the posterior portion of the left pelvic cavity. There was a marked impulse in the tumor with each heart beat. With one finger in the rectum and one in the vagina, the pulsation was markedly expansile in character; compressing the abdominal aorta stopped the pulsation in the tumor.

At the end of a month's observation and about six months after her child was born, when it was seen that the aneurism was increasing in size I determined to operate, hoping that I could obliterate the sac, after the plan suggested by Matas. A transverse Pfannenstiel incision was made with the belief that through such an opening one could more easily reach deep into the pelvis. But this was disappointing for I could not at any time during the operation see even a small portion of sac wall. The common iliac was followed to its point of division and the posterior iliac was tied by the sense of touch, with heavy catgut. When the ligature was tightened the pulsation entirely disappeared in the tumor. This operation was done in November, one and a half years ago. She still has a hard indurated tumor almost as large as before her operation, with a very slight pulsation in it, almost as though it were transmitted. This tumor causes her some pain in her left hip, but as she thinks it is decreasing, I have not advised her to have any further operation.

TRANSACTIONS

OF THE

AMERICAN SURGICAL ASSOCIATON.

Meeting held in Washington, D. C., May 6, 7 *and* 8, 1913.

The President, CHARLES A. POWERS, in the Chair.

ADDRESS OF THE PRESIDENT.

THE INFLUENCE OF THE AMERICAN SURGICAL ASSOCIATION ON THE PROGRESS OF SURGERY IN AMERICA.

The President, DR. CHAS. A. POWERS, of Denver, Col., delivered the opening address, for which see page 1.

FIBROMATOSIS OF THE STOMACH.

PROF. DR. ALEXIS THOMSON, of Edinburgh, Scotland, read a paper with the above title, for which see page 10.

DR. JOSEPH C. BLOODGOOD, of Baltimore, said that he had examined and seen at operation four cases of this disease. The thing which had impressed him most was the fact that in other lesions there is a similar production of connective tissue out of proportion to any known etiologic factor, one of these being in osteitis fibrosa. Another, in slight infections such as acne; again in desmoid tumors. He cited an instance of a patient suffering from leontiasis plastica in which a positive Wassermann reaction was obtained, the patient being treated by salvarsan preparatory to operation. In the four cases he had observed of fibromatosis he was surprised by the absence of adhesions between the peritoneum covering the stomach and the surrounding viscera, and also by the fact that in spite of the enormous increase in connective tissue throughout the wall of the stomach the peritoneal surface remained free.

DR. JOSEPH A. BLAKE, of New York, suggested that the condition of fibromatosis might be due to a very slight infection giving rise to a rather diffuse round-celled infiltration with marked reaction on the part of the tissue to the irritation, and that the same condition was apt to obtain in places where there are broad tissue planes, as in the neck and abdominal wall.

Dr. T. A. McGraw, of Detroit, cited a case of pyloric obstruction caused by a tumor the size of a hen's egg, the condition being relieved by a gastro-enterostomy with the elastic ligature, the patient living in perfect health for three years. At the end of that time he again developed intestinal obstruction. Operation revealed no adhesions around the stomach, no trace of the original tumor at the pylorus, no palpable glands, but a cancer of the large intestine immediately under the stomach though not in any way connected with this viscus. The patient succumbed to the operation and examination of the sections showed typical scirrhus carcinoma, with cheesy degeneration of the lymphatic glands.

Dr. Howard Lilienthal, of New York, referred to the two-stage operation for pylorectomy, first a gastro-enterostomy and then two weeks later a pylorectomy, stating that he was convinced that in at least two instances by following this procedure he had saved the patient from the necessity of the second operation. He therefore recommended that in performing operations for the relief of pyloric obstruction where there are no distinct metastases, the two-stage method be followed.

Dr. J. M. T. Finney, of Baltimore, stated that he had operated on cases of fibromatosis, doing simply an exploration or a palliative gastro-enterostomy, with the recovery of the patient and the disappearance of the tumor. He also cited a case of spontaneous cure without operation.

Dr. Charles N. Dowd, of New York, referred to a case of perforated gastric ulcer in which it was impossible to do a gastro-enterostomy because of the excessive infiltration, but in which two weeks later the infiltration had entirely disappeared. He mentioned a case treated by the two-stage operation, a big tumor being found at the first, and its disappearance at the second, but notwithstanding this the patient died of cancer.

Dr. George W. Crile, of Cleveland, reported a case in which he performed a gastro-enterostomy for supposed cancerous condition, but which later proved to be syphilitic.

Dr. Rudolph Matas, of New Orleans, stated that simple fibromatosis of diffuse type was a very rare condition. He also called attention to the fact that in the pathology of elephantiasis, which is a fibromatosis of the subdermal tissues, there were a great many analogies to this diffuse progressive form of fibromatosis encountered in the stomach. He referred to a case suffering from fibromatosis which was operated on under the impression that it was cancer, the mistake being discovered at autopsy.

Dr. Arpad G. Gerster, of New York, referred to a case of excision of a pyloric tumor diagnosed as carcinoma, where in the removal he found that he had cut through a substance very much resembling malignancy and therefore feared he had not made a wide enough excision, but on microscopical examination, although the body of the tumor was proven carcinoma, the surrounding material was a simple fibromatosis.

Dr. William B. Coley, of New York, declared that in his opinion the clinical signs with regard to these tumors of the pylorus are of more value than the microscopical report if the latter prove negative for malignancy, and cited a case in point operated upon by Dr. Mayo in which the clinical diagnosis was carcinoma, the pathologist failed to find any trace of this condition, yet the patient died two years later with general carcinomatosis.

DIAGNOSIS AND TREATMENT OF FRACTURES INVOLVING THE KNEE-JOINT.

Dr. John B. Blake, of Boston, Mass., read a paper with the above title, for which see page 27.

Dr. Harry M. Sherman, of San Francisco, did not agree with those who hurried the removal of the splint in fractures of joints, believing immobilization kept up for time sufficient to get solid union was imperative. He did not believe immobilization was the cause of ankylosis but that trauma to the joint itself did result in this condition because of adhesions. To strengthen this argument he referred to the long splint life of children with tuberculosis hip-joints in which absolutely no ankylosis resulted. With regard to passive motion, he argued that passive motion which produced pain produced trauma and should be guarded against.

Dr. Charles L. Scudder, of Boston, said that one should be guided, according as to whether the fragments had been reduced and the articular surface restored to the normal, in one's judgment regarding the time of relieving immobilization and beginning passive motion, calling attenton to the fact that a longer time is required where there is a large amount of callus, as in incomplete reductions. He also believed that immobilization did not cause ankylosis but that lack of reduction did.

Dr. George E. Armstrong, of Montreal, referred to the conclusion of the British Medical Association that the functional result in fractures is very largely dependent upon the anatomical result. He stated that there was but a slight tendency on the part of fractures to displacement after being once properly replaced, and stated that while in many cases the use of a foreign body was objectionable, his method of notching the ends of the bones even in spiral or oblique fractures would hold them in accurate position. He also said that in two cases he had made a dowel from a small portion of the crest of the tibia, inserting this into the medullary canal of the upper and lower fragments of the broken bone, and that this piece of living bone had done much to stimulate and increase repair.

Dr. Willy Meyer, of New York, called attention to the treatment of fractures of the elbow-joint proposed some fifty years ago by William Busch, who insisted that if the elbow be placed in three positions stiffness would not result. First, in the obtuse position in which the patient usually holds the arm when he presents himself for treatment, for ten days; then with a whiff of anæsthetic, conducting the arm slowly to the sharp right-angle position, keeping it there for ten days; finally, with another whiff of anæsthetic very slowly bringing it into the straight position with a splint on either side encased in a flannel bandage. He has had most satisfactory results with this treatment.

Dr. Henry B. Delatour, of Brooklyn, reported that in the last nine years he had had 78 fractures of the patella, all operated, with mortality of one; this was due to delirium tremens. Two cases of simultaneous fracture of both patellæ; in one case one patella operated on, then 12 days later the other patella: in the other case both operated upon at the same time. Method of operation employed was suture with chromicized catgut, particular attention being paid to the tear in the ligament. No drainage. Plaster splints from toes to middle of thigh for 10 days, then division of splint to leave a posterior splint, patella moved laterally at this dressing when the sutures are removed, and the posterior splint retained for three weeks; then removed at night, or in daytime, thus allowing the patient some passive motion in bed without any strain directly on the patella. No movements of the joint by the surgeon until after the fourth week. In only two of the 78 cases did he encounter trouble in getting motion; these two patients gave a previous history of rheumatism, and eventually good motion was obtained. Subsequent fracture of the opposite patella in four cases; refracture of the same patella in two cases. Dr. Delatour said that in compound fractures where he had used the Lane plate he had always had to remove the plate, and therefore he now inserted an ivory plate which never required removal.

Dr. Arpad G. Gerster, of New York, sounded a note of warning in the too great eagerness to follow the open method in fractures, and reported in detail a fatal case occurring in spite of the most careful precautions.

Dr. James E. Moore, of Minneapolis, considered that keeping the injured member quiet long enough to allow nature to bring about a natural healing in the bone, by letting the patient exercise it himself afterward, the greatest number of good results would be obtained. He considered it more important to treat most carefully joints in adults than in children with regard to the after-treatment. Great difficulty is sometimes encountered about the knee-joint after fracture of the neck of the femur in old people, and in such cases he advocated passive motion to the knee-joint.

Dr. Charles N. Dowd, of New York, said the results in bone injuries in children are much better than in adults, and that these results in children were much the same whether treated by the most improved or by the old-fashioned methods. He therefore emphasized the point that interference in children is not as necessary as in similar injuries occurring in adults.

Dr. John B. Murphy, of Chicago, said that the cause of most of the trouble in fractures of the elbow-joint was the luxation backward of both condyles; that this was more common than was supposed, and that it was absolutely essential that a differential diagnosis between fracture of both condyles and of only one condyle be made before treatment was instituted. In double fracture, dressing in full flexion, using the arm as a splint for the forearm, will bring the two condyles forward to a safe position. He emphasized also the point that when exercising a fracture it should never be carried to the point of causing pain to the patient.

Dr. John Bapst Blake, of Boston (in closing), stated that he had not infrequently encountered cases of fracture of the tuberosity in one or two long bones which had been diagnosed as sprains of the knee or rupture of the internal lateral ligament; in the latter case, that of rupture of the ligament, a fracture of greater or less extent should be considered present until absolutely disproved.

ANALYSIS AND STUDY OF 724 MAJOR AMPUTATIONS.

Dr. William Lawrence Estes, of South Bethlehem, Pa., read a paper with the above title, for which see page 39.

Dr. Nathan Jacobson, of Syracuse, considered that as most of the patients enter the hospital in a depleted condition one should promptly overcome that condition by intravenous saline transfusion and overcome shock by early operation. As to amputating through the knee-joint as advocated by the author, he preferred amputation through the upper third of the leg in order to save the knee-joint wherever possible. He reported two cases, one of quadruple amputation necessitated by a roller accident; the other of triple amputation due to contact with a live wire.

Dr. Howard Lilienthal, of New York, stated that in his experience in cases of gangrene due to arterial disease amputation at the knee-joint had been found wanting, gangrene because of deficient blood supply to the flaps being not uncommon: he preferred amputation in either the upper part of the limb or in the lower part of the femur. He stated also that it had been his habit for some years to make skin and muscle flaps rather than flaps of skin alone, in order to retain the nutritional supply, and that this being impossible about the knee, was another argument against selecting this point for amputation.

Dr. William S. Halsted, of Baltimore, advocated that when a patient was greatly shocked from loss of blood and it is not possible to do a transfusion, much benefit may be obtained by catching all oozing points with clamps and placing the patient in a warm bath. With reference to hip-joint amputations he said he had never seen a death from this operation and attributed this to the fact that the patient is in good condition before operation and no Wyeth pins are used, the operation being made absolutely bloodless by the use of clamps.

Dr. F. W. Parham, of New Orleans, advocated the advantage in some instances of using spinal anæsthesia, stating that he had resorted to this method in several cases with good results.

Dr. Alexis Thomson, of Edinburgh, suggested the advisability of performing major amputations in two stages, first blocking the nerves and dividing them, tying the arteries and subsequently the veins, and then at a second operation within two to four days finishing the amputation.

Dr. Willy Meyer, of New York, with regard to the question of anæsthesia in these cases suggested regional anæsthesia by injection of nerve ends, and also considered that intravenous anæsthesia would be worth a trial in such a large number of cases as fell to the author of the paper.

Dr. W. L. Estes, of South Bethlehem (in closing), considered that the fact that amputation at the knee-joint showed less mortality than in the upper third of the leg was sufficient to warrant its employment. He stated, in reference to Dr. Halsted's suggestion of a warm bath, that in many cases with large areas of torn tissue it would be impossible to carry this out because of the liability to sepsis. His method of amputation consists in the gradual dissection of the part without the use of Wyeth's pins; there is very little bleeding, and the after results are very good. So far as the two-stage operation was concerned he thought this should be taken into consideration, but in his opinion the dread on the part of the patient of a second operation far outweighed in effect the good results claimed for it.

CONGENITAL DISLOCATION OF THE HIP—A RATIONAL METHOD OF TREATMENT.

Dr. Harry M. Sherman, of San Francisco, Cal., read this paper.

He pointed out that in congenital dislocation of the hip, all the components of the joint, femoral head and neck, acetabulum and capsular ligament, are variants, in greater or less degree, from the norms, and that of these the capsular ligament, elongated and narrowed, is the chief obstacle to easy or complete entrance of the femoral head into the acetabulum, while the twisted femoral shaft, which gives the neck and head a forward direction instead of one inward and but a little forward, is the chief cause of reluxation and the assumption of the position called the anterior transposition. Therefore the writer advocates and practises reposition through an incision. This, placed between the tensor vaginæ femoris and the long head of the rectus femoris, cuts no nerves and naught else than connective tissue in exposing and entering the capsular ligament. Through this incision the narrow part of the capsule is reached and freely cut, and then, in the great majority of cases, in children of proper age, the head can be easily lifted into the acetabulum. Later, to prevent a reluxation, an osteotomy of the femoral shaft is done below the trochanters, and the lower fragment is rotated outward while the upper fragment is held in such a position that the head and neck are properly correlated to the acetabulum as well as to the rotated out shaft. The method of holding the upper fragment, consisting of head, neck and trochanters, is by driving into the shaft, between the trochanters, a suitable steel nail the end of which projects and can be incorporated in the plaster-of-Paris dressing. The method of estimating the functional value of the head and neck and the presence or absence of the antetorsion of the shaft of the femur by radiograms is given, and the character and time of use of plaster-of-Paris splints. The osteotomy is accorded a place of considerable value, for the cases of satisfactory joints, that is, joints that are practically normal functionally, even though they varied from the conventional norm anatomically, was but 41.3 per cent. before the osteotomy became a part of the technic, while 70.3 per cent. of satisfactory joints are secured since the osteotomy is practised in all cases that need it.

Dr. William S. Halsted, of Baltimore, reported a case of a patient operated upon at the age of five years in which he encountered a very small head and a twist of the neck of the femur which made extreme rotation necessary to hold the joint in position, the slightest deviation from this permitting popping out of the head. This child was kept in this position with extreme rotation, the splint being changed every week, for about six months, and now, some twenty years later there is a perfect development of the hip.

THE SURGERY OF THE CARDIOVASCULAR SYSTEM.

Papers were read as follows:

By Dr. Francis T. Stewart, of Philadelphia, entitled: Five Cases of Suture of the Heart; by Dr. Willy Meyer, of New York, entitled: The Surgery of the Pulmonary Artery; by Dr. George Tully Vaughan, of Washington, entitled: Aneurisms Treated by the Matas method; by Dr. Leonard Freeman, of Denver, entitled: Arteriovenous Anastomosis in Threatened Gangrene of the Foot; by Dr. Rudolph Matas, of New Orleans, entitled: Observations on the Surgery of the Aorta; and by Dr. W. S. Halsted, of Baltimore, entitled: Partial Occlusion of Aorta by Spiral Bands of Fresh Aorta Wall. For these papers, see preceding pages of Annals of Surgery.

Discussion.—Dr. F. B. Lund, of Boston, called attention to the value in these cases of employing the Meltzer-Auer intratracheal insufflation apparatus, reporting a case in which he had used this, the operation being the removal of a sarcoma of the chest wall with three ribs, and in this case, as in others, the result had been most satisfactory. He emphasized the advantage of the employment of this apparatus where the pleura is to be widely opened and where there are no adhesions of the lung to the chest wall.

Dr. Howard Lilienthal, of New York, in reference to Dr. Freeman's paper, said that in arteriovenous anastomoses the technic was of prime importance, and considered it most important to use the very finest needles that can be handled, No. 13 or No. 14, together with 6 0 silk well vaselined. He considered the end-to-end suture the best as it afforded the minimum chance of thrombosis.

Dr. James E. Thompson, of Galveston, cited a case of suture of the heart, in which it was believed that the right ventricle was penetrated; autopsy, however, showed that the wound was in the interventricular septum.

Mr. Alexis Thomson, of Edinburgh, reported a case in which an arteriovenous anastomosis was done first on one side, and at a subsequent time on the opposite side for threatened gangrene; the anastomoses being of the femoral artery and vein at the apices of Scarpa's triangle. This same patient still later developed a hemiplegia and at her own request her common carotid was anastomosed with her internal jugular vein.

Dr. Willy Meyer, of New York (in closing), said that although all agreed that under most circumstances the Meltzer-Auer intratracheal insufflation was indicated, yet there were cases in which the cough reflex was advantageously retained, and that in such cases this apparatus encountered the mouth to such an extent that one of the other pressure apparatuses was indicated.

LARYNGECTOMY FOR CANCER.

Dr. George W. Crile, of Cleveland, read a paper with this title, for which see page 164.

Dr. Joseph C. Bloodgood, of Baltimore, discussed the metastasis in the glands of the neck in laryngeal cancer, referring to cases operated on for cancer of the larynx followed by recovery and subsequently dying from metastasis in the glands of the neck. He emphasized the fact that the inability to palpate these glands is no indication that they are not involved. He also advised that the operation of laryngectomy be done under novocain.

PERIOSTEAL ROUND-CELLED SARCOMA OF FEMUR.

Dr. William B. Coley, of New York, read a paper with this title, for which see page 97.

Dr. Albert J. Ochsner, of Chicago, reported a case of inoperable round-celled sarcoma of the ilium which was opened, the diagnosis made and confirmed, and the patient treated by the Coley toxins with apparent recovery; two years later a new tumor appeared in the same region, increased rapidly in size; toxins again administered but without effect, the patient succumbing to the condition. Autopsy revealed the fact that the secondary tumor was not a sarcoma but a cyst at the bottom of which was a carcinomatous degeneration. This case convinced the speaker that the same micro-organism is the cause of sarcoma and of carcinoma under different conditions.

Dr. William H. Welch, of Baltimore, called attention to the fact that, in the sections examined, apparently different opinions were reached but that in reality this was due to the fact that different portions of the tumor showed different conditions, there being in fact two tumors, a sarcoma and an epithelioma. He considered it unfortunate that the sections of the primary growth are not obtainable in order that a definite opinion might be reached as to whether the recurrence is of the same or a different type of cell.

Dr. Joseph C. Bloodgood, of Baltimore, said in reference to the supposition that the secondary growth in Dr. Coley's case might have resulted from the X-ray treatment, that he had a patient now seven years after a primary and two secondary growths operated upon and treated by the X-ray. He was of the opinion, however, that the result obtained in Dr. Coley's case, of disappearance of the tumor and an interval of ten years before reappearance, justified in inoperable cases the trial of the mixed toxins of erysipelas and bacillus prodigiosus.

Dr. William B. Coley, of New York, drew attention to the fact that although sporadic cures were sometimes noted as of spontaneous occurrence, which rather proved them not to be of malignant nature, he had always had his specimens examined not by one but by several pathologists in order to reach as correct a diagnosis as possible, and that even with such convincing proof of the malignant nature of the cases, he had been able to report various cases as cured by the use of the mixed toxins of erysipelas and bacillus prodigiosus.

SARCOMA OF THE CHEST WALL.

Dr. Fred B. Lund, of Boston, read a paper with the above title, for which see page 206.

CARCINOMA OF THE THYROID WITH INVOLVEMENT OF LUNGS THROUGH THE BLOOD-VESSELS.

Dr. Francis J. Shepherd, of Montreal, read a paper with the above title, for which see page 109.

Dr. Charles H. Mayo, of Rochester, Minn., emphasized the accepted fact that the younger people are affected with malignancy the more rapidly it is disseminated through the lymphatics and the circulation in general, and that therefore the cure of thyroid cancer will as a rule only be in people between 50 and 70, the total removal of the gland being indicated. He also laid stress upon the necessity of an X-ray examination of thyroid carcinoma cases in order to rule out involvement of the chest and lung, stating that no secondary carcinoma of the breast should come to operation without this precaution being taken.

THE SURGICAL TREATMENT OF GRAVES'S DISEASE.

Dr. William S. Halsted, of Baltimore, read a paper with the above title, discussing especially the excision of both lobes, and the ligation of the inferior in preference to the superior thyroid artery, for which see page 178.

HYGROMA CYSTICUM COLLI.

Dr. Charles N. Dowd, of New York, read a paper with the above title, for which see page 112.

Dr. John B. Murphy, of Chicago, called attention to the fact that in hygroma cysticum colli if only a portion of the tumor is removed there is a rapid return with enormous increase in size and secretion, and that these frequently undergo malignant degeneration.

Dr. Joseph C. Bloodgood, of Baltimore, said that he had encountered a number of cysts in the neck lined with endothelium, having no apparent connection with the blood system, and had also seen them in the axilla and groin, occurring without trauma. Three of these cases, which in all number less than 20, have been malignant, evidenced by the presence of blood and papillomatous growths of the cyst wall, these papillomata making excision extremely difficult if not impossible. He advised early removal of hygromata to avoid malignancy, which seems to be a late development.

DIAGNOSIS AND TREATMENT OF BORDER-LINE PATHOLOGICAL LESIONS.

Dr. Joseph C. Bloodgood, of Baltimore, in his paper said that by border-line pathological lesions are meant those in which it is difficult, clinically, or from the gross appearance, or from the frozen microscopic section, to come to a definite conclusion as to whether a lesion is benign or malignant. The earlier after the first symptom patients present themselves for treatment, the greater will be the number of cases in which the diagnosis will present difficulties; in this stage the prognosis after proper treatment is best. It is the opinion of the author that we have sufficient experience at the present time to allow us to formulate definite conclusions as to the proper method of diagnosis and treatment in this stage in which the result should be the best. Incomplete removal of any malignant disease in its earliest stage gives much worse results than complete removal in a later stage; this fact must be always borne in mind. Incomplete removal of a distinctly benign lesion, with the exception of the angioma, is always followed by the reformation of the tumor from the residues left behind, and the chances of malignant change in these residues are greater than in the undisturbed benign lesion; this fact also should be kept in mind.

These border-line pathological lesions, from the standpoint of diagnosis and treatment, can be divided into three great groups.

Group I. In this instance the complete excision of the palpable nodule can be accomplished without danger and without mutilation, so that after its removal it makes little difference what the microscope shows: the proper operation has been done.

Group II. Here also the complete excision of the nodule can be accomplished without danger or mutilation, but there is a possibility that the lesion may be a carcinoma of a type in which, experience has demonstrated, the neighboring lymphatics should also be radically extirpated.

Group III. In this series the diagnosis of malignancy would indicate a more radical operation with mutilation and, in some instances, increased dangers from the operation, while, if the lesion were still benign a cure could be accomplished with less or no mutilation and less danger.

From his investigations the author is confident that we have sufficient evidence to indicate to the surgeon the proper operation in each group with best results for the patient.

In the first place, the surgeon must have the easily available knowledge of the different pathological processes which may occur in definite localities. He must be familiar with the methods of diagnosis of the lesion in this special region and the nature and extent of the operation which promises the best results. The diagnosis as to the proper treatment rests upon, first a careful study of all the available clinical evidence. In some cases this is sufficient to indicate the proper treatment without a gross or microscopic investigation. This is true for palpable masses in the stomach and colon. The resection of such masses, without an investigation of their gross and microscopic pathology by cutting into them, yields the best results with the least mutilation and danger. If the pathological examination after their removal shows a benign lesion the patient is protected from the later development of cancer; if, on the other hand, it should prove to be malignant, the chances of a cure are best.

As examples of Group I, we may mention benign pigmented moles, warts, small subepidermal nodules, and subcutaneous more or less encapsulated tumors.

In the second group we may mention a lesion on the lower lip. Here the lesion may be radically excised with a V-shaped piece without danger or mutilation, and the wound closed. Then a frozen section is made and if it proves to be a carcinoma of the spinocellular type, the glands under the jaw should be completely removed through a separate incision. This operation in two stages and without continuity dissection has been demonstrated to fulfill all the requirements. With an early lesion on the tongue the method is entirely different, because for the malignant nodule or ulcer the local operation must be more extensive. In a case of this kind, under general or local anæsthesia, the palpable area is excised with the cautery and immediately studied under the microscope in a frozen section. If the section shows carcinoma, then the more radical operation must be proceeded with at once.

As an example of Group III, may be used a lump in the breast, one in which a clinical diagnosis is impossible. The surgeon cuts down upon the lump. In the majority of cases the differential diagnosis between benign and malignant is best indicated by the gross findings. In many instances the frozen section is more difficult to interpret than the gross pathological picture. In a few instances the frozen section is helpful, for example, between an intracanalicular myxoma and a medullary carcinoma.

The next important question to answer is, what shall a surgeon do when in doubt after he has exhausted clinical, and gross and microscopical pathological investigation. It is the author's opinion that we have sufficient evidence to answer this question. It rests upon the knowledge of the frequency of malignant disease in the different regions and the results of radical treatment. In the breast, the complete operation for cancer should always be performed for any lesion in a woman over 25 unless the benignity of the lesion is established. The complete operation should follow immediately upon the exploratory incision. This conclusion is based upon the fact that the mutilation of the complete operation is but slight, the additional danger is little if any, while the probabilities of a cure of the malignant tumor, subjected to complete operation in this doubtful stage, is 80 per cent. or more; if the operation is done in two stages the chances of a cure are reduced to almost nothing.

In bone lesions the mutilation of amputation is so great and the chances of a cure of any doubtful lesion, should it prove malignant, are so slight, that the most conservative operation should always be chosen. This is also true for doubtful lesions in the nasopharynx and antrum, on the alveolar border of the jaws, and in the body of the lower jaw.

Dr. Bloodgood is confident that if surgeons will carefully investigate these lesions clinically, scrutinize their gross appearance and look at the frozen sections, and keep a check on their results up to date, they will soon be in a position to meet the requirements of the diagnosis of these border-line pathological lesions inasmuch as immediate treatment based upon this investigation will lead to a removal of the lesion, giving the patient the best opportunity of a cure with the least mutilation and danger.

As the campaign for the education of the people on the early signs and symptoms of what is or may be cancer bears fruit, surgeons will be called upon more and more to treat these lesions in a stage in which accurate diagnosis is more difficult and where the dangers of incomplete removal, following an inaccurate diagnosis, increase with the space of time between the first signs and symptoms of the disease and the date of treatment.

Dr. John B. Murphy, of Chicago, agreed with the author that the final court of appeal in these cases is the clinical result and not the microscopical report. He reported a case of sarcoma of the patella, the first symptom of which was slight pain on trauma. A month or so later the patient while walking along the street was struck on the patella by a lady's handbag which the owner was swinging in her hand, and this caused him exquisite pain. On operation the condition of sarcoma of the patella was diagnosed, resulting in amputation.

Dr. Charles H. Mayo, of Rochester, Minn., suggested that in border-line pathological lesions where an exploratory operation could not immediately, if necessary, be followed by diagnosis from a frozen section, the wound, even though the condition be considered benign, be packed with Harrington's solution No. 9 for several days until a microscopical report could be obtained. He particularly emphasized the point of not closing such a wound, advocating that it be left open and drained and the lymphatics burned with hydrochloric acid.

Dr. Arpad G. Gerster, of New York, called attention to the possibility of tumors in the breast being either of tuberculous or syphilitic origin, therefore not requiring amputation, referring to many instances, however, where amputation has been performed under the impression that these conditions were malignant. He also spoke of involution mastitis based upon gout, of actinomycosis in the breast, and of the various systemic disorders which may be accompanied by swellings in the breast, emphasizing the point that not all swellings in the breast are necessarily on their way to malignancy.

Dr. Robert B. Greenough, of Boston, said that the hope of increasing the number of cures from malignant disease was based on the patients being seen in the early stages. He advocated that, even in the early stages of suspected cancer of the breast, the whole breast with the pectoral fascia be removed.

THE SURGICAL ASPECT OF PURPURA.

Dr. James F. Mitchell, of Washington, read a paper with the above title, for which see page 258.

Dr. Francis B. Harrington, of Boston, reported an instance in which he had performed a laparotomy presumably for obstruction, but on opening the abdomen an œdematous condition was found, the abdomen closed, and the diagnosis of purpura made.

Dr. Charles A. Porter, of Boston, Mass., likewise reported a case in which a bowel resection was done, the condition later proving to be nothing but angioneurotic œdema.

REMOVAL OF STONES FROM THE KIDNEY AND URETER.

Dr. John H. Gibbon, of Philadelphia, read a paper with the above title, for which see page 232.

Dr. Francis S. Watson, of Boston, said that, in his experience, bilateral calculus had occurred in 30 per cent. of cases and simultaneously in 19 per cent. He had always obtained good results by performing a simultaneous bilateral operation in these cases, and considered this procedure had the advantage of freeing the patient from all his trouble at one sitting. In cases in which anuria is present he considers one is justified in a unilateral operation (both kidneys containing stones) only when the first kidney is seen to be so little damaged that there can be no doubt that it can maintain life by its own unaided functional secretory work.

Dr. Alexander Primrose, of Toronto, Canada, suggested the advisability of opening a dilated ureter at a point slightly above the stone, removing the stone by means of forceps, suturing the wound, and instituting drainage.

Dr. Gibbon (in closing) said that with regard to Dr. Primrose's suggestion it would be impossible to adhere to such a procedure in a case with a mulberry stone without producing unnecessary trauma of the ureter. He agreed with Dr. Watson's remarks in reference to bilateral renal calculi, laying stress upon the point that the stones might also be found in both ureters rather than in the kidney substance itself.

EXCLUSION OF THE BLADDER.

Dr. Charles H. Mayo, of Rochester, Minn., read a paper with the above title, for which see page 133.

Dr. Francis S. Watson, of Boston, reported the case of a patient in one of whose loins he established a permanent renal fistula by nephrostomy 16 years ago, doing the same operation on the opposite side 9 years ago, and stated that during these many years with the exception of 4 months the patient has been kept perfectly dry, free from odor, comfortable and in excellent health. He devised an apparatus (previously fully described) for receiving the renal drainage. He urged the employment of nephrostomy as being superior in results to ureterostomy stating that the advantage of the more easy performance of the latter procedure was far outweighed by the satisfactory results of the former operation, and described in detail the technic of the nephrostomy procedure. He emphasized the point that in inserting a drainage tube into the kidney it should be carried just within the entrance of the calyx into the renal pelvis, and that care should be taken to avoid having it press too hard against the wall of the renal pelvis lest it cause ulceration; this drainage tube should be of large size, which might make it necessary to stretch or enlarge the mouth of the calyx where it joins the renal pelvis.

Dr. Harry M. Sherman, of San Francisco, reported the progress in a case in which he did the Petersen operation for exstrophy of the bladder in a child of three years, some 12 years ago. The patient has developed most satisfactorily. Five years ago he was operated upon for inguinal hernia, and the speaker thought it was most interesting and instructive to find that even with the absence in this case of the pubic bone the anatomy of the hernia had still been preserved. At this operation he investigated the condition of the ureters in the rectum, found them in excellent condition and with no indication of an ascending infection.

Dr. Robert G. Le Conte, of Philadelphia, considered that experimentation had shown that the extension of infection upward is not through the lumen of the ureter but by means of the lymphatics along the course of the ureter. The longer the anastomosis, or the more ureter covered by intestine in implantation into the intestinal wall, the greater the liability to ascending infection.

Dr. John J. Buchanan, of Pittsburgh, considered the possibility of ascending infection being due to the fact that the cut end of the ureter is in reality the cut end of a mucous canal, which contracts, causing dilatation of the ureter and pelvis of the kidney, and thus predisposing to infection. He also stated that he believed before one could intelligently deal with this question it would be necessary to learn what effect was produced upon the patient by injection into his rectum of large quantities of his urine prior to operation. He had reached this conclusion after losing a case because of evident poisoning from this source.

SURGERY OF THE PANCREAS.

Dr. William J. Mayo, of Rochester, Minn., read a paper with the above title, for which see page 145.

PANCREATIC LYMPHANGITIS.

Dr. John B. Deaver, of Philadelphia, read a paper with the above title, for which see page 151.

ACUTE DIVERTICULITIS OF THE SIGMOID IN CHILDREN.

Dr. Joseph Ransohoff, of Cincinnati, read a paper with the above title, for which see page 218.

EXCISION OF THE INFARCT IN ACUTE HÆMATOGENOUS INFECTIONS OF THE KIDNEY.

Dr. Lucius W. Hotchkiss, of New York, read a paper with this title, for which see page 226.

RUPTURE OF THE BLADDER.

Dr. George Woolsey, of New York, read a paper with this title, for which see page 244.

LEGAL RESPONSIBILITY TO THE SURGEON WHICH THE USE OF THE X-RAY INVOLVES.

Dr. Ellsworth Eliot, Jr., of New York, presented this paper, which was read by title.

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ORIGINAL MEMOIRS.

ŒSOPHAGOPLASTY.

BY WILLY MEYER, M.D.,
OF NEW YORK.
Attending Surgeon to the German and Post-Graduate Hospitals.

IN cases of inoperable carcinoma of the thoracic portion of the œsophagus, the old methods of gastrostomy (Witzel, Kader, Ssabanejew-Frank, Senn) should be resorted to, as they are not serious operations and their functional results are good.

However, if the tumor in the œsophagus is to be extirpated, the mere establishment, for feeding purposes, of a fistula below the costal arch, is nowadays no longer a sufficient procedure. The whole operation, including the making of the gastric fistula, should be planned with a view to reconstruction of the œsophagus—"œsophagoplasty," viz., the making of a tube which will enable the patient to swallow his food and pass it down into the stomach.

Lexer and Frangenheim each succeeded at about the same time in giving a patient with impermeable cicatricial stricture of the œsophagus extrathoracically a new, useful tube by a series of plastic operations. (1910–11.)

Both employed the combined methods of Roux and Wullstein who exclude and then transpose under the skin of the chest a coil of the jejunum, of which the lower end is connected with the gastric fistula and the upper end with the oral stump of the œsophagus by a skin-plasty.

Next to the necessity of the seriatim operating, the threatened necrosis of the transplanted jejunal coil represents the weak point of this otherwise ingenious procedure.

At this stage of the evolution of the subject in question, it meant real progress when Jianu proved by a number of successful operations upon dogs that the major curvature of the stomach can be used for the formation of a tube, of which one end remains in connection with the gastric fundus, while the other free end can be brought up under the skin of the thorax to a point not far from the clavicle.[1] Before him others had tried to solve the task in a similar manner, Depage[2] making use of the lesser curvature; Hirsch[3] of the anterior wall of the stomach.

Not long after the publication of Jianu's article, Roepke tried the method for the first time on a patient with cancerous stricture of the œsophagus, and it proved a perfect success.[4]

In December, 1912, a female patient, forty-six years of age, came under my care at the German Hospital who had found increasing difficulty in swallowing for the last six months. A sound showed a stricture nine and one-half inches behind the incisor teeth, and the X-rays revealed the presence of a stricture involving several inches. Œsophagoscopy was difficult on account of abundant salivation and mucous accumulation in the œsophageal pouch above the narrowed lumen. In view of the contemplated resection of the œsophagus, Jianu's method of gastrostomy, which represents the first stage of extrathoracic œsophagoplasty, appeared clearly indicated. The operation was done on December 26, 1912, the procedure of Roepke being followed pretty closely, as follows:

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[1] Gastrostomie und Œsophagoplastik. Deutsche Zeitschrift für Chirurgie, vol. 118, p. 383, 1912.

[2] Résultats d'une nouvelle méthode de gastrostomie, x French Surg. Congr., 1903.

[3] Plastischer Ersatz des Œsoph. aus dem Magen. Centralbl. f. Chirurgie, 1911, N. 48.

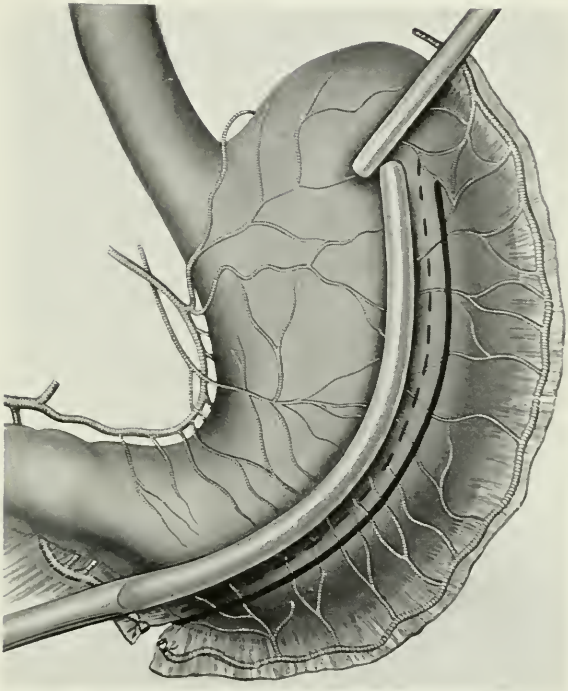
[4] Centralblatt f. Chirurgie, No. 46, November 16, 1912.

After exposing the stomach by a median incision from the xyphoid process to the umbilicus, tying off the major omentum up to the place where the left inferior gastro-epiploic artery turns on to the stomach, and after double ligation and division of the right inferior epiploic artery about two inches from the pylorus, a mattress suture of silk was run through the entire thickness of the stomach about one and one-quarter inches distant from and parallel with the greater curvature (Fig. 1, dotted line), the stomach having been lifted up by the assistants in order to have the contents run toward the lesser curvature. This part of the operation could have been simplified had a suitable clamp, better still two clamps, corresponding in shape to the major curvature, been at hand. (See Fig. 1, which is taken from Jianu's article.) In placing two equally shaped clamps alongside of each other, parallel with the major curvature, the asepsis of this part of the operation can be materially improved (see further down).

The thread of the mattress suture was clamped close to the fundus of the stomach opposite the last ligature of the greater omentum, and then an incision made through the stomach along this suture. (See Fig. 1, dark line.) The portion of the stomach thus dissected was temporarily wrapped in a piece of sterile gauze. Then a second continuous silk suture, commencing again at the major curvature, inverted that part which had been closed by the mattress suture, so that the width of the stomach was reduced to about two-thirds of its normal size. After this second thread had reached the place where the mattress suture had been clamped before, it was knotted to this and then continued as a Connell stitch up to the tip of the stomach flap, transforming the latter into a rather wide tube which connected with the fundus. (Fig. 2.) It was provided with a good blood supply and covered all around with peritoneum. A second continuous seromuscular suture was added alongside this new tube, as is done in gastro-enterostomy. The length of the new tube was 25 cm. (9¼ in.).

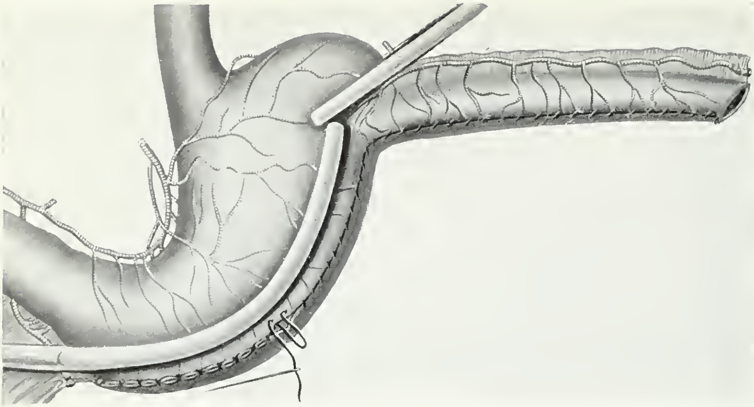
Thereupon the stomach, thus mobilized, was turned so that the base of the tube was lying at the upper end of the median abdominal incision, right below the xyphoid process. Placed upon the surface of the thorax, the free end of the tube easily reached up to the cartilage of the third rib, without any stretching of the tube. Over this cartilage, about one inch to the left border of the sternum, a horizontal incision 1½ in. in length was now made, down and through the fascia of the pectoralis major muscle, the fibres of the latter bluntly divided and a tunnel bored below the muscle with a large curved clamp. With the tip of the latter, when it emerged into the upper end of the abdominal wound, were caught the threads (left long) of two inverted sutures, which had been placed in order to temporarily occlude the tip of the newly formed tube, and drawn up and out of the upper chest wound, until the occluded tip of the tube projected for about half an inch. Now the abdominal wound was properly closed by sutures, the upper ones catching the stomach on their way, thus lifting it up, and the end of the new tube opened up by cutting the two inverting sutures, and fastened to the borders of the small chest wound. (Fig. 3.) Of course, this opening of the tube might be done twenty-four to thirty-six hours later, as, for instance, with the sigmoid in inguinal colostomy. However, with proper care asepsis can be nicely maintained and it is better for patient and surgeon, if the work can be finished at the time of the first operation. In this case the asepsis was disturbed later on by a fascia necrosis, due to gangrene of the seromuscular coat of the uppermost extremity of the new tube, the gangrene having been caused by fastening the tube in place with through and through sutures, which evidently constricted the vessels. This proved to be a technical mistake. In view of the fact that the nourishing vessels enter the new tube in a horizontal direction, its seromuscular coat should *not* be surrounded by the sutures which have to anchor the top end of the new tube. *The mucosa alone* should be lined to the borders of the skin wound. Nevertheless, the patient was up and about on the ninth day after operation; she was presented before the New York Surgical Society on the twelfth day, Jan. 8, 1913. (See ANNALS OF SURGERY, Transactions of the New York Surgical Society, April, 1913, No. 4, pp. 586 and 587.) So far the intended thoracotomy could not be done on account of a perichondritis of the rib cartilage and also of the border of the sternum, to which the submuscular suppuration had spread. Meanwhile the patient enjoys full diet, the food, after thorough chewing and salivation, being deposited in some kind of warm fluid and then washed down into the stomach through a funnel. Weight is slowly increasing. She permanently wears a large sized rubber

Fig. 1.



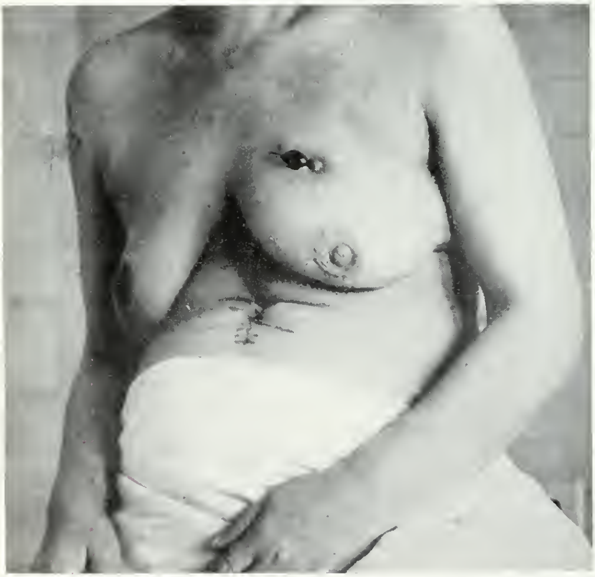
Major omentum has been divided (proximal ligatures are not shown in illustration Right inferior epiploic artery doubly ligated and divided. It is wise to clear about three-fourths to one inch of the major curvature of the stomach toward the pylorus of omentum plus vessels. (This step, also, is not brought out in the illustration.) In the case reported no clamps were placed, but only the mattress suture (dotted line) which shut off the new tube from the rest of the stomach. The heavy black line represents the direction in which the scissors divided the stomach. (Taken from Jianu's article.)

FIG. 2.



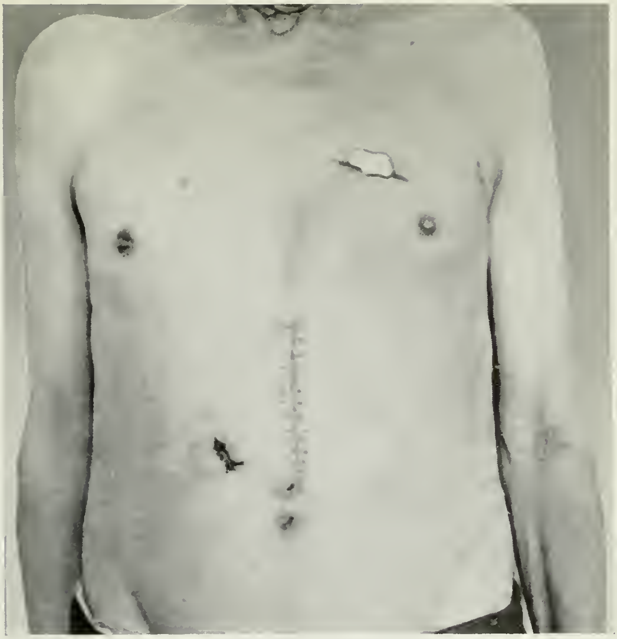
"Jianu tube" turned up; the second row of sutures (Lembert) is placed; note the splendid blood supply and pointing upward of the proximal portion of the major omentum which, after transposition of the tube to the outside of the chest, points to the right side of the patient. The one end of the tube remains in connection with the fundus of the stomach; the free end represents the gastrostomy opening, which eventually can be sutured to the lower end of the transposed oral stump of the œsophagus, after resection of the intrathoracic carcinoma has been accomplished. (Also taken from Jianu's article.)

FIG. 3.



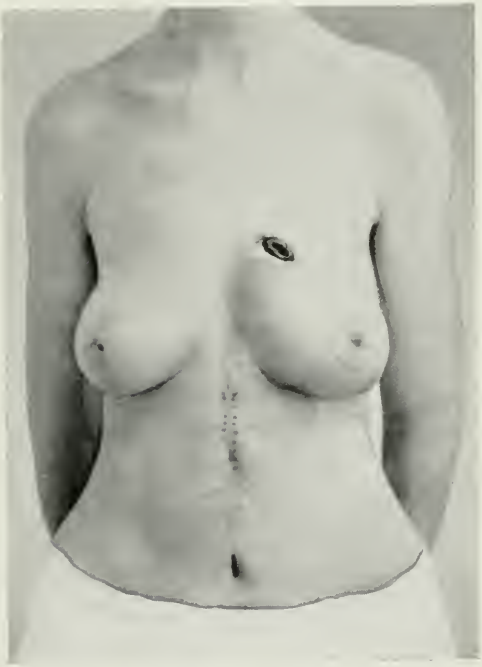
Photograph of the first patient, forty-six years old, who was operated upon at the German Hospital according to Jianu-Roepke's method on December 26, 1912, as described in this article.

FIG. 4.



The second case, male, sixty-eight years old, operated upon at the German Hospital, March 24, with the help of Hültl's wire stitching instrument.

FIG. 5.



Third case emale, forty-one years of age, also operated upon with the help of Hültl's instrument on March 27, 1913.

tube within the Jianu-tube because the latter—also in consequence of the sub-muscular suppuration—developed a leak in the line of the continuous silk suture.

Ordinarily it will not be necessary for the patient to wear a rubber tube; a small piece of dry gauze will close the Jianu opening between meals. If this is not satisfactory, either a permanent tube can be worn, with the outer end plugged, or, as our observations have shown, the tube may be compressed with a piece of gauze held down by a strip of adhesive plaster placed across the chest. A truss-pad, filled with water or glycerine, held in place by straps around the thorax, will answer the same purpose. The new tube communicates freely with the fundus of the stomach. Regurgitation of food and stomach secretion can occur, producing excoriation of skin.

On basis of operations on dogs, we have recently made use to great advantage of Hueltl's wire stitching instruments in the formation of the Jianu tube in two patients, March 24 and 27. The operation on the stomach is thereby rendered absolutely dry and, of course, more aseptic; the time of the operation is also shortened. Both patients were operated upon with the help of intravenous ether anæsthesia and are doing nicely. In one the new tube is 19 cm. long (Fig. 4), in the other 21 cm. (Fig. 5.) In both the gastrostomy opening corresponds to the level of the third rib. In one of them I could have easily placed it level with the second rib, had I put the tube on the stretch.

With regard to the question of the subpectoral or subcutaneous placing of Jianu's tube. I feel inclined, even with the limited experience thus far had, to favor the subcutaneous way, for, though usually the operation will run an aseptic course, a local infection may nevertheless occur, and in that event it will be easier to cope with the subcutaneous than with a submuscular seat of inflammation. Besides, the latter may spread to periosteum of rib and sternum, or the perichondrium of the ribs, which always means a tedious convalescence.

Furthermore, since recent developments have shown (Ach's patient living 17 days after resection of the œsophagus, Torek's first successful case of resection of the œsophagus for a carcinoma behind the aortic arch) that the subcutaneous transposition of the oral stump can be done also in the human being without endangering nutrition, it would seem an advantage to have both tubes, the œsophageal stump from above and the Jianu tube from below, meet on the same level, for if they should not be long enough to make end-to-end union possible, a skin plasty would have to be done.

In thinking over this plan of operation, the question has arisen in my mind: How shall we proceed if the first stage of œsophagoplasty has been done by Jianu's method of gastrostomy in a case of carcinoma of the œsophagus with the idea of resecting the tumor in the second stage, and the case is then found inoperable.

It seems to me it would be advisable in such an event, nay, even indicated, to go ahead, same as we do within the abdomen in the case of an inoperable carcinoma of the pylorus. Here we do a gastro-enterostomy to alleviate the patient's misery. We tell his relatives the true state of affairs, but he believes—at least for a time—that he is cured; a palliative, humane treatment.

The greatest hardship for patients with malignant œsophageal stricture is their inability to swallow. Their principal desire is to have this restored. Why not then, if on thoracotomy a case is found inoperable, divide the œsophagus proximal to the tumor and invert the distal end. Then transpose the oral stump under the skin of the neck and chest and, if long enough, unite it with the opening of the Jianu tube. If it proves too short, a connecting rubber tube (Gluck, Perthes) will re-establish swallowing of liquid and semifluid food. If this should prove unsatisfactory, a skin plasty will have to be made to bridge the defect and thus complete the extrathoracic œsophagoplasty.

Even in cases where the tumor apparently totally obstructs the œsophagus, there is usually still sufficient drainage through a narrow and tortuous canal in the centre of the tumor down into the stomach, same as Madelung's operation (division of the sigmoid, inversion of the distal end and implantation of the proximal end in the abdominal wall) has shown the practicability of this method in cases of inoperable rectal carcinoma.

Further experience and observation is needed to find out how long the transposed oral stump of the œsophagus may be without becoming necrosed. It certainly is of the greatest importance for the patient's future, that partial gangrene with the ever-occurring subsequent phlegmon of the surrounding tissues should not set in.

In cases, in which examination previous to operation shows the cancer to be located between the aortic arch and the cardia, or right at the cardia itself, then, it has been my recent practice in animal experimentation, assuming this condition, to bring up the tube *intrathoracically,* through the foramen œsophageum of the diaphragm into the pleural cavity, and to make an end-to-end anastomosis between it and the oral stump of the œsophagus. (Intrathoracic œsophagoplasty).[5] A patient cured by this procedure would live on after the operation the same as he did before he became afflicted with the cancer. The only drawback of this latter, seemingly ideal procedure is, that according to present indications, the entire work has to be done in one sitting, whereas in extrathoracic œsophagoplasty Jianu's operation can be done in the first sitting and resection of the œsophagus with transposition of the oral œsophagus stump in the second. Perhaps a way can be worked out experimentally how to make the intrathoracic œsophagoplasty also a two-stage operation.

The introduction of Jianu's operation, comprising as it does, the first stage of extrathoracic œsophagoplasty—very likely also the possibility of carrying out intrathoracic œsophagoplasty—appears to have advanced by another great step the surgery of the œsophagus, which is now making headway by leaps and bounds.

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[5] Centralbl. f. Chirurgie, February 22, 1913, No. 8.

SOME SURGICAL FEATURES OF INJURIES OF THE SPINE, WITH SPECIAL REFERENCE TO SPINAL FRACTURE.*

BY CHARLES A. ELSBERG, M.D.,

OF NEW YORK.

THE LESSER INJURIES TO THE SPINE AND THEIR SIGNIFICANCE.

INJURIES to the spinous and transverse processes and laminæ are very frequent, and not a few of the conditions that are ordinarily called "sprains of the back" are really fractures of part of a vertebra, or rupture of a vertebral ligament. The many joints and bony processes surrounded and held together by strong ligaments, and the surrounding muscles, are the explanation for the remarkable strength of the vertebral column and its resistance to injuries. But the peculiar structure of the spine offers also many opportunities for fractures, for rupture of ligaments, etc. For several years I have been having X-ray pictures taken of the spines of patients who had sustained slight injuries of the back, and have been surprised by the frequency with which a fissure or fracture or part of a spinous process or tip of a transverse process has been found. These comparatively slight injuries usually cause no symptoms besides the local pain and tenderness; there is, perhaps, some stiffness of the back, and the symptoms are soon relieved by rest and simple remedies. A week or two after such an injury, the patients seem to have fully recovered, although for many months they may have some backache when they arise in the morning. We do not know, however, how often such a slight trauma may be the starting point of a long drawn-out spinal disease, of a hæmatomyelia, a syringomyelia, or one of the spinal glioses or scleroses—

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* Read before the Springfield Academy of Medicine, February 12, 1913.

those diseases whose origin is still enshrouded in darkness and whose nature is but ill understood. Slight trauma of the spine may be a very important factor in the etiology of many spinal diseases.

RUPTURE OF SPINAL LIGAMENTS.

Rupture of a spinal ligament is a very frequent injury, and one to which much too little attention has been paid in the past. The most important ligaments in this connection are the ligamenta subflava or flava, which bind together the laminæ of the vertebræ and thus contribute to making a complete canal for the spinal cord. After slight injuries to the back I have seen, in two instances, very severe and perplexing symptoms arise. Both patients had sustained an injury to the back of so slight a nature that they only spoke of it when closely questioned, both suffered from what was at first supposed to be a severe sciatica which had resisted prolonged treatment. In both patients the X-ray showed that there had been an injury to the bony spine, in both the laminectomy revealed a ruptured ligamentum subflavum; both were entirely relieved by the operation.

Case I (reported in detail in *Surgery, Gynæcology and Obstetrics,* March, 1913).—Mrs. C., forty-nine, thrown out of automobile ten months before. Severe pain over distribution of the fourth lumbar spinal root on the left side. X-ray shows thickening of arches of fourth and fifth lumbar vertebræ. Laminectomy, June 25, 1912, showed that the left lamina of the fourth lumbar vertebra had been fractured and the ligamentum subflavum torn off and rolled up so as to make pressure on the fourth lumbar posterior root. Excision of ligament and division of thickened posterior root was followed by complete and permanent relief.

Case II.—M. C., twenty-two years of age, admitted to the service of Dr. Bailey at the New York Neurological Institute in February, 1913. Eighteen months before, patient was thrown out of grocery wagon when his horse ran away. He landed on his back and several boxes fell upon him. For three or four days he was unable to sit down on account of pain in the buttocks but otherwise felt well. Six months later he began to have intermittent cramps in the left leg, and the leg soon became stiff. Pain became constant after several months and he would feel it down the back of his leg to the heel. The pain interfered much with walking, and was made worse by exercise. No other symptoms.

Physical Examination.—Left knee and ankle jerks slightly exaggerated, slight diminution in sensation over distribution of third and fourth lumbar roots on the left side; slight stiffness of entire left extremity, tenderness on pressure over sciatic nerve. X-ray shows evidence of an old lesion between the fourth and fifth lumbar vertebræ.

Laminectomy (February 13, 1913).—Removal of spines and laminæ of second, third, and fourth lumbar vertebræ in usual manner. The laminæ, and especially the fourth, were much thickened and the spinal canal much narrowed. The cauda was bent backward at an angle and the dura was reddened on its inner surface at the spot of greatest angulation. All of the thickened bone was removed and the left fourth lumbar root divided.

Convalescence uneventful. Patient was discharged relieved of his symptoms on March 1.

Both of the above patients had undergone a prolonged treatment for sciatica. The X-ray made the clinical picture clear, and showed us that we had to deal not with a nerve but a radicular symptom.

It is possible that among the cases that are grouped as sciaticas, there may be some in which the symptoms are due to a spinal lesion, as in my two patients; in these, operative interference with removal of the pressure upon nerve-roots is indicated, and should be followed by immediate relief.

FRACTURES OF THE SPINE.

Fractures of the spine occur most often either in the midcervical (fourth to sixth cervical) or the lower dorsal (eleventh, twelfth dorsal, first lumbar) regions. In the cervical region, the spinal canal is large and the vertebræ are freely movable upon each other, while in the dorsilumbar region the canal is relatively narrow and the vertebræ more fixed upon each other.

The importance of a fracture of the spine—and for the sake of brevity I shall include under this head all severe injuries to the vertebral column which are ordinarily described as fracture dislocations, no matter whether there is a fracture with or without some dislocation or a dislocation with or without some fracture—lies not in the fracture itself but in the injury that has been done to the spinal cord. Whenever the treatment of recent fracture of the spine is under discussion, we always hear most conflicting opinions—some claiming that a fresh spinal fracture should never be operated upon, others being equally emphatic in their statements that all or most spinal fractures should be subjected to operation. The supporters of this latter view base their belief upon the fact that if irremediable injury to the cord has been done, the operation will not make matters worse. Let us consider both sides of the question.

Fractures above the fourth cervical vertebra are usually followed by death, either at once or after a few hours, from injury or compression of the medulla, and are therefore never cases for operation.

In what other patients is immediate operative interference justified or imperative? Unless the patient's condition is so poor that any interference is contra-indicated, I believe that an operation is called for when we have evidence that there is compression of the cord by bone or blood or when there has occurred considerable contusion of the cord. Operation is indicated in all of these patients if the symptoms of a cord lesion are not well marked. By " not well marked " or " incomplete " symptoms of cord injury I mean symptoms from which one may conclude that there are still numerous pathways up and down the cord unaffected—there is only a partial loss of power below the level of the fracture, sensation is well preserved over considerable areas below the level of the lesion, many of the reflexes are preserved, the control of the bladder and rectum is little or not interfered with.

In those patients with "incomplete" cord symptoms, an X-ray examination should be made as early as possible, in the patient's bed, and evidence of bone pressure thus obtained. A lumbar puncture should be done at once, for this will show us whether there is a large amount of blood in the dural sac. If the X-ray fails to show any marked bony deformity, and the lumbar puncture reveals little blood within the dura, then we may be fairly certain that the symptoms are to a great extent due to a contusion of the cord.

Now a contusion of the cord is soon followed by an œdema of a very destructive nature or by bleeding into the spinal substance. The œdema is very apt to cause, within a few days, a complete and irremediable transverse lesion of the cord, but its spread can be prevented by the decompressive effect of the laminectomy, to which may be added a direct incision into one of the posterior columns of the cord near the posterior median septum (Allen). A small collection of blood within the cord substance may be safely withdrawn by means of aspiration with a fine needle, and the formation of a hæmatomyelia cavity in the cord prevented.

You may ask, where is the pressing need for operation in these patients with "incomplete" cord symptoms? Is it not better to wait and see how the case will progress? It is true that from the standpoint of danger to life, no hurry is necessary. But our aim should be to have, if possible, a perfect functional recovery. The constant pressure of bone will cause degenerations in the cord which can never be recovered from, the same is true of intraspinal blood clots, and I have already spoken of the danger of œdema of the cord. Most satisfactory results can be obtained by early operation—complete recovery of function—and good but incomplete recoveries follow late operations. In experienced hands, the danger of a laminectomy is small. The operation can be done very quickly—under local anæsthesia if necessary. In this connection, I want to relate the history of a patient who recently came under my observation, who might have been saved if early operation had been performed.

Mrs. H., sixty-four years of age, the mother of a physician, was seen by the writer on the evening of February 1, 1913. The previous night the patient tripped and fell down stairs, striking upon her back. She at once complained of severe pain between the shoulder-blades and said that her legs felt weak, although she was able to move them. Examination by several physicians showed that there was a fracture of the spine at about the sixth cervical vertebra, patient was able to move her arms freely, although she complained of some pain shooting down the arms; she could move her lower limbs somewhat and the knee-jerks were preserved; sensation was lost below the level of the umbilicus.

The case was not considered one for operative interference. The symptoms steadily grew worse, so that when I saw her the anæsthesia extended up to the neck; there was complete loss of motion and sensation of the lower limbs and trunk, and almost complete loss of power in the upper extremities. All reflexes were gone, as were control of the bladder and rectum. Very soon afterward the patient began to have difficulties in swallowing.

I believe that this patient might have been saved if she had been operated upon within a few hours of the accident, when there were "incomplete" cord symptoms.

If, on the other hand, immediately after the accident, the patient has a complete loss of motor power and sensation with loss of superficial and deep reflexes below the level of the lesion, and with loss of control of bladder and rectum, we know that there is probably a complete and irremediable transverse lesion of the cord, and no operation is justified. Operative interference can do no good but only harm. If the injury is in the cervical region, death will be hastened by the operation—no matter how quickly and skilfully it be done. The disrepute into which operations for recent fracture of the spine with injury to the spinal cord have fallen is due to a great extent to the fact that patients with a transverse cord lesion have been operated upon. In a very few cases, improvement has followed the operation, but in these patients there could not have been a transverse lesion in the cord, and it is questionable whether recovery might not have taken place if the operation had been delayed. Undoubtedly there are rare cases which at first present the symptoms of a transverse cord lesion but which recover to a great extent, thus proving that no transverse lesion had existed.

OPERATIVE INTERFERENCE IN OLD FRACTURES OF THE SPINE.

In the present state of medical opinion regarding the indications for operation in recent fracture with injury of the spinal cord, it is inevitable that many patients are allowed to go on without surgical interference who should have been operated upon. I have been asked to see patients many months or years after their injury. In some of these patients, the symptoms of cord injury were not very marked for weeks or months after the accident, but after a time signs of serious and progressive interference with the cord functions appeared. In other patients, the early signs of cord injury cleared up to a certain extent and improvement soon ceased. In many of these patients the X-ray examination[1] made long after the injury showed that, due to the original injury or perhaps to new bone deposits, there was a marked narrowing of the vertebral canal and therefore pressure on the cord, or a partial dislocation of the body or a lamina of one or more vertebræ, which caused a decided angulation of the cord. I have described a number of these cases in a previous paper.[2]

Many of these patients are incapacitated on account of well-marked paralyses of one or several extremities. As I have shown in the paper referred to, they can be greatly benefited by a free laminectomy with wide removal of spinous processes and laminæ well out to the intervertebral foramina, and exploratory opening of the dural sac. By this means, a narrowed spinal canal can be widened, pressure of bone upon nerve roots in the intervertebral foramina be removed, and a marked angulation of the cord straightened out by allowing room for the dural sac and cord to bulge backward. In some of these patients the prominence on the posterior surface of the body of a vertebra can be removed extradurally by drawing the dural sac to one side after the laminectomy has been performed, and removing the bony prominence upon which the cord is almost spitted. In most cases, the dura must be incised and the cord examined. Adhesions between the cord and the inner surface of the dura may be found and divided. A localized cyst or hæmatomyelia cavity may be found in the cord substance, laid open and drained.

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[1] X-ray pictures of the spine should always be taken from at least two sides—an anteroposterior and a lateral view.

[2] Loc. cit., S. G. & O., March, 1913.

CONCLUSIONS DRAWN FROM AN EXPERIMENTAL INVESTIGATION INTO THE PRACTICABILITY OF REDUCING THE CALIBRE OF THE THORACIC AORTA BY A METHOD OF PLICATION OR INFOLDING OF ITS WALLS, BY MEANS OF A LATERAL PARIETAL SUTURE APPLIED IN ONE OR MORE STAGES.*

BY RUDOLPH MATAS, M.D.,

AND

CARROLL W. ALLEN, M.D.,

OF NEW ORLEANS, LOUISIANA.

(Laboratory of Experimental Surgery, Tulane University,
New Orleans, La.).

The purpose of the experiments, which were exclusively performed on dogs, was to find a substitute for ligatures, or metallic or other constricting bands, intended for creating stenotic or atresic circular constrictions in the thoracic aorta, all of which, in our previous experience, had proved dangerous and impracticable in the upper aortic tract, the more dangerous and fatal as they approached the heart.

The circular purse-string sutures, applied in series and imbedded in the aortic wall, which had been first tried by Haecker, in 1908, were not considered, because his experience sufficiently proves that any circumferential constriction applied to the upper aorta with sufficient force to narrow the lumen of the vessel, is almost invariably followed by ulceration and fatal hemorrhage. Haecker's sutures were applied to the first portion of the aorta immediately outside of its origin in the heart. In five experiments, three dogs died from hemorrhage during the intervention. In the fourth, the completion of the suture was abandoned on account of profuse bleeding from a stitch hole. The last animal, which survived the intervention, died twelve days later from erosion hemorrhage caused by the pressure of the knot.

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* Read before the American Surgical Association, May 7, 1913.

In our experiments, the object sought was to produce a gradual stenosis of the aortic lumen by infolding or plaiting the walls of the vessel in its longitudinal axis. In applying these sutures, they were made as nearly interstitial or interparietal as possible. Our experience, and that of others (Carrel, Haecker, Guleke) proves conclusively that through-and-through sutures in the walls of the aorta of dogs, applied with any tension, are liable to cut through and are followed by secondary hemorrhage from ulceration and necrosis when fatal hemorrhage does not occur from the immediate cutting through of the sutures in the course of the operation.

In the abdominal aorta this danger is lessened by the greater firmness and better quality of the vessel walls and by utilizing the peritoneum which is included in the grip of the sutures, as well as by the marked tendency here to the formation of organizable plastic exudates which further support and encapsulate the line of suture. This tendency is almost entirely absent within the thorax. In addition, the line of suture may be fortified with strips of this membrane wrapped spirally around the vessel, a procedure which Jeger seems to have recently carried out independently of our work.[1]

Our experience also entirely confirms the observations made by Carrel and Guleke, who found that the walls of the thoracic aorta become progressively more friable as the heart is approached. Sutures applied to the ascending arch are much more liable to tear through and cause hemorrhage than the same sutures applied to the descending arch. In the ascending aorta the elastic media is the dominant coat and the fibrous adventitia is apparently too thin to offer any resistance to traction under the great strain and tension of the arterial stream in this region. The intima, though thick, offers little or no support to the sutures, as it is extremely soft and cuts through like wax under the pressure of the stitch. Some idea of the softness of the coat may be obtained when examining an aorta freshly removed from a dog. If placed on a solid surface and the vessel is firmly creased with the finger nail applied to the external coat, then opened and exposed, it will be found that the intima has been cut as with a knife. This peculiar friability of the ascending aorta in dogs, does not appear to be dependent upon the age of the animal, because, as Guleke has already noticed, it is sometimes observable to a very marked degree in young animals.

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[1] Professor Halsted in his epochal and masterful paper on The Effect of Ligation of the Common Iliac Artery on the Circulation and Function of the Lower Extremity, which was published in the *Johns Hopkins Hospital Bulletin,* of 1912 (see bibliography), refers to recent experiments performed upon the abdominal aorta with ligatures and tissue bands, which are quite pertinent to our inquiry. His experiments refer chiefly to the abdominal aorta, which are quite different from those on the arch and thoracic aorta. On page 217 he writes: "We noted in our experiments that the aorta of dogs after having been totally occluded by silk ligature, may again become patulous. This restoration of the lumen is brought about by the cutting through of the ligature, and has usually been accompanied by the formation of a diaphragm of greater or less extent (see also *Jour. Exp. Med.,* 1909, vol. xi, No. 1). Similar obser-

The plication of the aorta, as we have practised it, is carried out as follows: With a full curved intestinal needle (Pb No. 5, or straight milliner's needle, No. 16), in which we, in the earlier stages of this work, used No. 1 surgeons' silk (Corticelli twisted), often using it double, but later using a somewhat heavier material, the vessel wall is caught through its thickness outside the intima and at points directly opposite each other and approximated by tying. The sutures were

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vations have been made upon the human subject after the ligation of large arteries (innominate, subclavian, femoral). Acting on this hint given by Nature, I tested last winter on thirteen dogs the effect of partially occluding ligatures of fine silk, placed one above the other on the aorta, hoping that we might obtain a series of superimposed diaphragms which, if sufficient in number and extent, might sufficiently obturate the aorta to bring about the cure of the aneurism.

"But these partially occluding ligatures of fine silk, not only produced no diaphragms but gave rise, in two of the thirteen dogs, to fatal hemorrhages. From the totally occluding, crushing, coarse silk ligature in dogs, I have seen no such case of hemorrhage. Was then the fineness of the silk, or the incompleteness of the occlusion responsible for the bleeding? Or were both concerned in bringing about the result?

made continuous in our earlier work, but recently interrupted sutures, of the mattress type, have been preferred. The line of suture is made parallel to the long line of the vessel for a variable distance of from one to three inches. The infolding of the vessel wall progresses with each suture. The sheath of the vessel and the overlying pleura are not disturbed but included, whenever it is available, in the grip of the suture. During the suturing process no clamps are placed upon the aorta, only a tractor of stout silk or tape is passed under the vessel, in order to better draw it into the field. While the pulsations offer some disadvantage, it is much easier to work on the distended vessel, as one is better able to judge of the degree of penetration of the needle as well as determine the amount of constriction produced by each succeeding stitch than when working on a collapsed vessel. Furthermore, there is less interference with the heart's action, thus permitting a more deliberate and more prolonged work, the total occlusion of the aorta, on the proximal side of the carotid origins, being fatal in from one to four minutes.[2]

In our experiments no attempt was made to occlude the aorta, but a tractor of stout silk was passed around the vessel, at the origin of the left subclavian, in order to steady the vessel and bring it nearer the surface. The advantage of the

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[2] Our experience also confirms the observations made by Carrel and Guleke, as well as those of Lawen and Sievers, in regard to the short time that occlusion can be applied to the ascending arch without fatal consequences. Carrel found that in experimenting on dogs a total constriction of thirty-two seconds' duration can be tolerated without permanent damage to the brain. According to this investigator, the descending aorta can be compressed for seventeen minutes without fatal heart strain.

Our experiments show that a permanent contraction or narrowing of the aortic lumen in the thoracic aorta outside of the left subclavian, sufficient to obliterate the femoral pulses or to make them practically imperceptible, is tolerated by the heart of vigorous normal dogs sufficiently to permit of recovery by the rapid development of the collateral circulation.

Lawen and Sievers, in their experimental research upon "the influence of artificial respiration, strophanthin and adrenalin, upon the heart's action after a temporary occlusion of the aorta and of the pulmonary artery, in the performance of Trendelenburg's operation for the traction loop over all forms of compressing devices is that it permits the aorta to be brought near the surface, closer to the operator, without necessarily arresting the circulation; it also allows the operator to familiarize himself, before beginning to suture, with the ability of the heart to adjust itself to varying degrees of occlusion. When traction is made on the loop sufficiently to constrict the lumen of the aorta, the heart reacts by rapid, very irregular and weaker beats than normal. However, it gradually adjusts itself to the obstruction, and contracts with regularity though with less rhythmic and less vigorous contractions. When the loop is relaxed, the sudden change in the resistance which the heart has had to overcome, again causes irregularity in the heart's action which gradually subsides to normal, if the traction is not renewed.

When the suture is satisfactorily applied, dogs tolerate with impunity a reduction of one-fourth to one-third the circumference of the vessel. After an interval of three to six weeks, a second plication is attempted, beginning just below the point where the first terminated, though occasionally the second plication was made over the first. The second plications were carried to a degree which still further reduced the calibre of the vessel, so that only a small pulse could be felt in the distal part of the aorta below the suture.

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extraction of pulmonary emboli," found that the extreme brevity of the time during which these vessels, for hæmostatic purposes, can be occluded with any safety to the animals (rabbits) was the chief difficulty in the operation. Lawen and Sievers performed a series of experiments to determine if it were not possible to prolong this stage of the operation by adopting different procedures. They occluded the aorta and pulmonary artery temporarily by tying a ligature around these vessels with just sufficient force to arrest the blood current and not damage the artery. They arrived at the following conclusions: The occlusion of the aorta and pulmonary artery cannot be prolonged beyond two and one-half minutes without causing the death of the animal. Death is preceded by a cessation of respiration and of heart beat. If artificial respiration is continued by intratracheal insufflation the ligature may remain *in situ* three and one-half to four minutes, beyond which recovery is impossible. If pure oxygen is insufflated into the lungs instead of atmospheric air, the occlusion of the blood-vessels may be maintained five and one-half minutes. The injection of artificial serum into the

The first operation is remarkably well sustained by the animals. The majority survive and recover rapidly, and the fact that in our experiments 75 of the animals survived sufficiently to undergo a second plication shows not only that the heart adjusts itself thoroughly to the demands made upon it by the obstruction, but that the collateral circulation is ample provided the heart is healthy and the animal young and vigorous, and a sufficient time is allowed to elapse for the animal to recover from the effects of the primary interference.

In the early part of our experimental work the error of over-plicating and encroaching too much upon the aortic calibre, was committed and in consequence a fatal paraplegia and other evidences of ischæmia of the spinal cord and lower extremities were recorded. When death has occurred in our later cases, it has been due either to intrathoracic infection, or marasmus induced by intestinal and cardiac parasitism with the dog filaria, which is a very common form of parasitism in the dogs of our section, or by accidental hemorrhage and pleural infection at the time of the operation.

All the experiments were conducted with artificial respiration by intralaryngeal insufflation with a soft rubber catheter introduced into the trachea through the glottis by the Meltzer-

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carotids, charged with oxygen to prevent asphyxia of the nerve centres, is less positive in its results.

In this series of experiments, the circulatory arrest could continue over five and one-half minutes, on an average, without absolutely fatal consequences. By applying massage to the heart as an excitant to the cardiac muscle, combined with oxygen insufflation, a compression of the vessels could be prolonged to six and one-half minutes. By injecting adrenalin (25 mg.) into the heart immediately after the untying of the occluding ligatures, while artificial respiration with oxygen was being kept up, they were able to save animals which had been occluded seven to eight minutes.

While the heart can stand a complete ischæmia for ten minutes, by total occlusion of the superior and inferior vena cavæ (Rehn *v.* Haecker, and Sauerbruch), the brain, especially the medulla which is far more sensitive, will not tolerate a total ischæmia, even with artificial respiration by intratracheal insufflation, beyond two and one-half minutes in rabbits, and scarcely, with any degree of safety, beyond one and one-half minutes in dogs and more highly organized animals.

Auer method. The intralaryngeal tube was attached to the Matas-Smyth pump, which permits the volume of insufflated air to be regulated with nicety and also permits of cumulative positive pressure with greater certainty, when required in inflating the lungs, better than with the ordinary bellows. In our later work, however, it was found equally practicable to use an ordinary foot bellows attached to an ether vapor anæsthetizing chamber. After introducing the tube into the trachea, the thorax is opened in the fourth left interspace by an intercostal incision (Mikulicz-Spangaro) extending from near the left sternal margin to the posterior axillary line. With strong self-retaining retractors, the ribs are separated for about three inches, giving a clear view of the heart, arch, and upper part of the thoracic aorta and hila of the lungs. In this way, the left pleura is opened; the air is continuously introduced into the lungs and allowed to escape in the usual way alongside of the laryngeal catheter. After the plication has been accomplished, and before closing the thoracic incision, the lungs are expanded to a maximum, in order to expel all air from the pleura and are held to the chest wall by cumulative positive pressure long enough to complete the hermetic suture of the pleura and the intercostal space. We agree with Guleke that this is a very important detail in the technic, because if air is allowed to remain in the pleura the full expansion of the lungs is interfered with, allowing a partial pneumothorax to remain, which is followed by a profuse transudation of serum. In turn, this is secondarily infected, causing a septic pleurisy which often ends in the death of the animal in a few days. This will often happen, in spite of the most rigid asepsis and after every precaution has been taken to pack off the lungs and pleural cavity with warm sterile salt towels, leaving only the upper part of the aorta exposed in the field of operation.

Since our experience in plication, which Dr. Allen first began in May, 1910, 151 dogs have been subjected to the primary plication.

Of these, 73 were plaited a second time, and of the 78 remaining, 4 died of hemorrhage, 7 of infection, and 3 from the anæsthetic. Some of the remainder were sacrificed for study, while others died of parasitism or disease, or escaped through accident or neglect on the part of the laboratory employes.[3]

Of the 73 secondary plications, 29 died of hemorrhage; 15 of parasitism and marasmus from various causes; 7 from post-operative pleural infections; 4 escaped; 4 died of the anæsthetic, while attempting a third stage, or total occlusion, operation; in 3 no cause of death was determined.

Of the 11 which reached the third or obliterative stage of plication, 6 died of hemorrhage; 2 from pleural infections on the fourth and seventh days; 3 from parasitism and probably cardiac asthenia.

In all the more recent cases, the line of suture could be recognized though buried in a relatively thin layer of exudates; in others, the suture line was still better recognized when a shorter lapse of time had occurred between the operation and the death of the animal. In the older cases, three weeks or longer, the suture line was not clearly discernible, being deeply buried in the organized exudates and in the vessel wall which was always thickened at the line of suture. Some of the sutures relaxed, but all remained under the cover of a thin exudate layer.

The examination of the two specimens obtained from the animals dying of pleural infections, showed the line of suture fresh and thoroughly recognizable through a layer of exudate. A cross section of the sutured segment showed a very great encroachment upon the lumen of the vessel by the plicated fold which practically packed the lumen but not sufficiently to prevent the circulation of fluids under pressure. The narrow space intervening between the convexity or bulge of the fold and the ensheathing arterial wall always becoming apparent and wider whenever fluid was forced through it.

The three animals dying after a lapse of three, four, and

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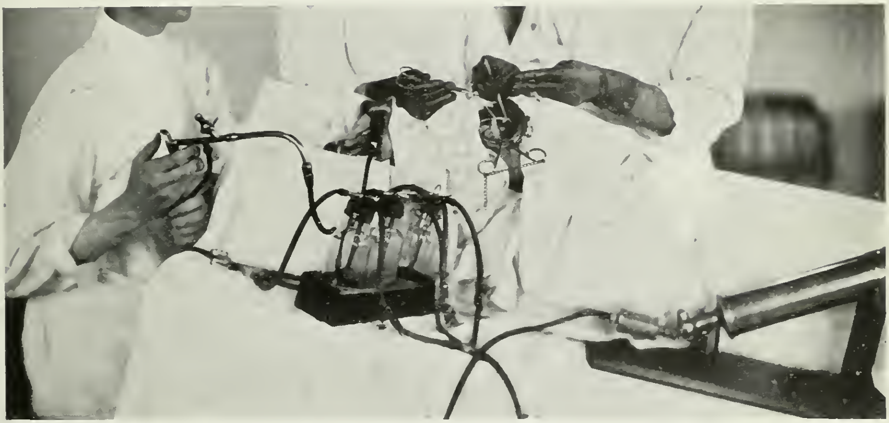
[3] On one occasion a whole pack of experimented dogs were liberated at the close of the winter's work, for economic reasons. On another occasion a number of dogs that had survived the first and second plications were set free through the efforts of persons residing in the neighborhood of the college, to whom the yelping and barking of the dogs had been annoying, the animals being kept in an open enclosure in the college grounds.

seven days respectively, showed, as in all the dogs that had survived, a marked plication, a hypertrophy and dilatation of the left ventricle which had no doubt been initiated by the obstacle put in the way of the aorta by the first plication. The specimens of the plicated segment, in this last group, exhibited the same gross characteristics noted in the previous two cases, viz.: in all, the lumen was crowded and packed tightly by the plait of the infolded wall, narrowing it to a slit-like space, though the actual degree of obstruction varied to some extent in the different animals. In all, the infolded mass or plica, practically filled the aortic lumen, but in animals that had longest survived the operation, the potential space existing between the infolded mass and the wall was greater than in those dying within a shorter time. The causes of death in these instances were multiple. The immediate causes were: cardiac asthenia, or exhaustion, in which the previous and long standing efforts of the heart to overcome stenosis in otherwise marasmic and enfeebled animals played the chief part. In one of these dogs, the cardiac action was embarrassed by the presence of a large swarming mass of adult filaria which filled the right heart (see Fig. 5). The other two dogs had also been greatly enfeebled by uncinariasis, which is as prolific a cause of disease in the dog, as in the human species and is especially prevalent among dogs kept in captivity and in unhygienic surroundings. In all the dogs that reached the third stage of plication, the nutritional conditions were bad, leading practically to a marasmic state from prolonged confinement in the laboratory and in small enclosures which still further reduced the resistance of these animals to trauma and cardiac strain.

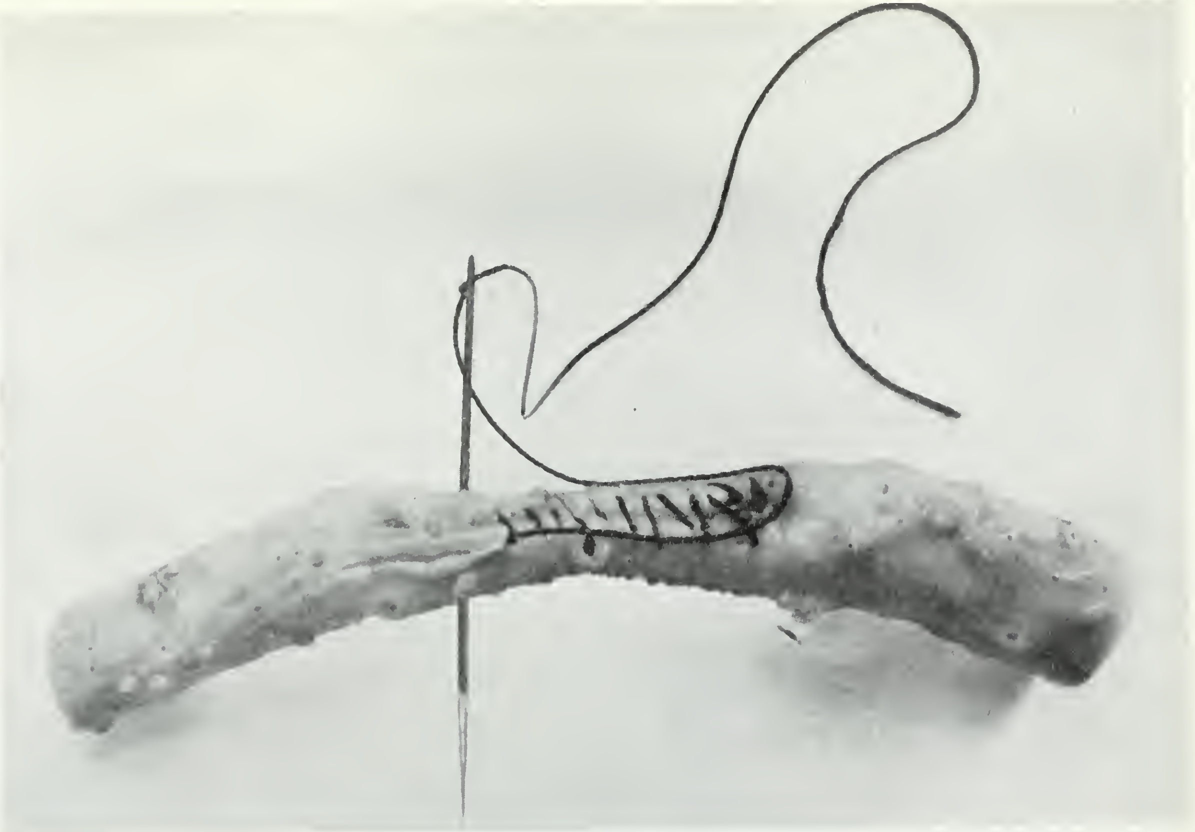
It is interesting to note that, as previously stated, in these extreme cases of stenosis, some of the animals were able to survive as long as seven days and finally died without showing any of the evidences of peripheral ischæmia, palsy of the hindquarters and other disturbances which are characteristic of acute aortic obstruction whether from experimental or purely pathologic causes (ligatures, bands, thrombi, etc.). The absence of these special phenomena is to be accounted for by the gradual reduction of the aortic circulation, brought about by the previous plications in two sittings at long intervals, by the compensatory hypertrophy of the cardiac muscle and by the development of

FIG. 1.



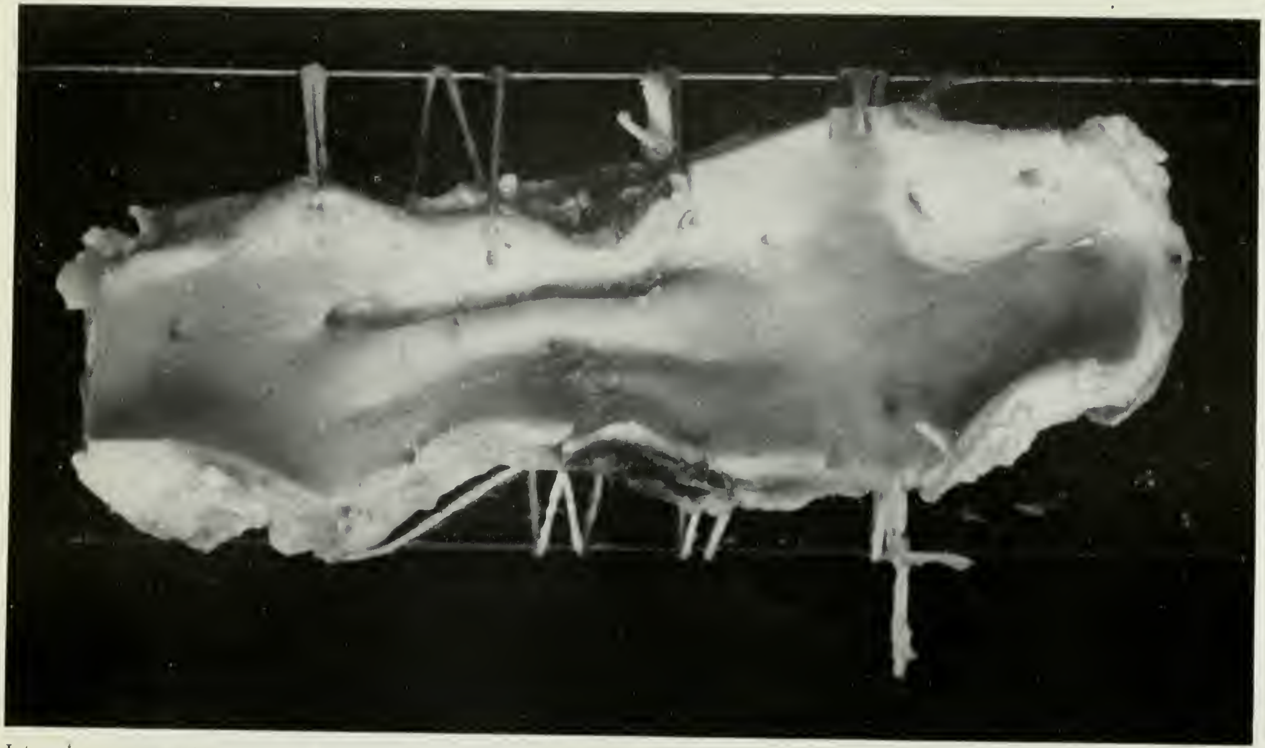
Showing general arrangement of operating table with dog on frame, Matas-Smyth pump in operation. Self-retaining retractor in position, between third and fourth left ribs, exposing thoracic cavity. Tractor of stout silk passed around aorta at origin of left subclavian, drawing heart and vessel up into wound; parts of lung seen in background above and below heart. Needle is being passed through adventitia of aorta.

FIG. 2.



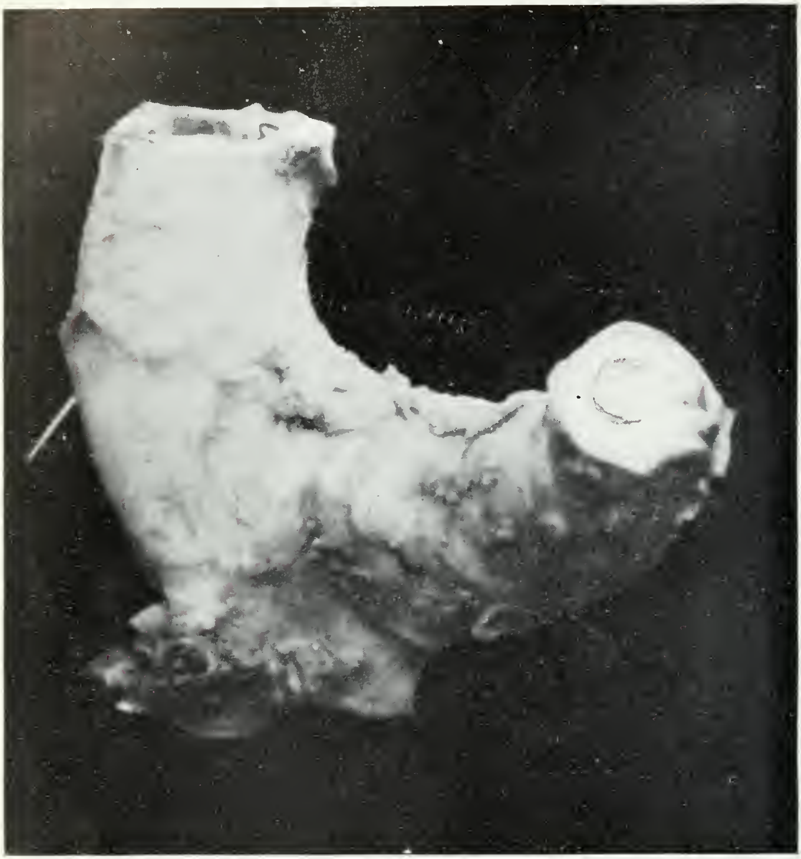
Section of aorta magnified three times, showing method of plication. Needle is seen transfixing two folds on walls of aorta with groove between. The apparent depth of the needle, as indicated in the photo, is due to the vessel being covered by cellular tissue and pleura. The coarse and woody appearance of the specimen is due to the hardening effect of the formalin solution in which it was preserved. The same observation applies to all other specimens shown in these photographs.

FIG. 3.



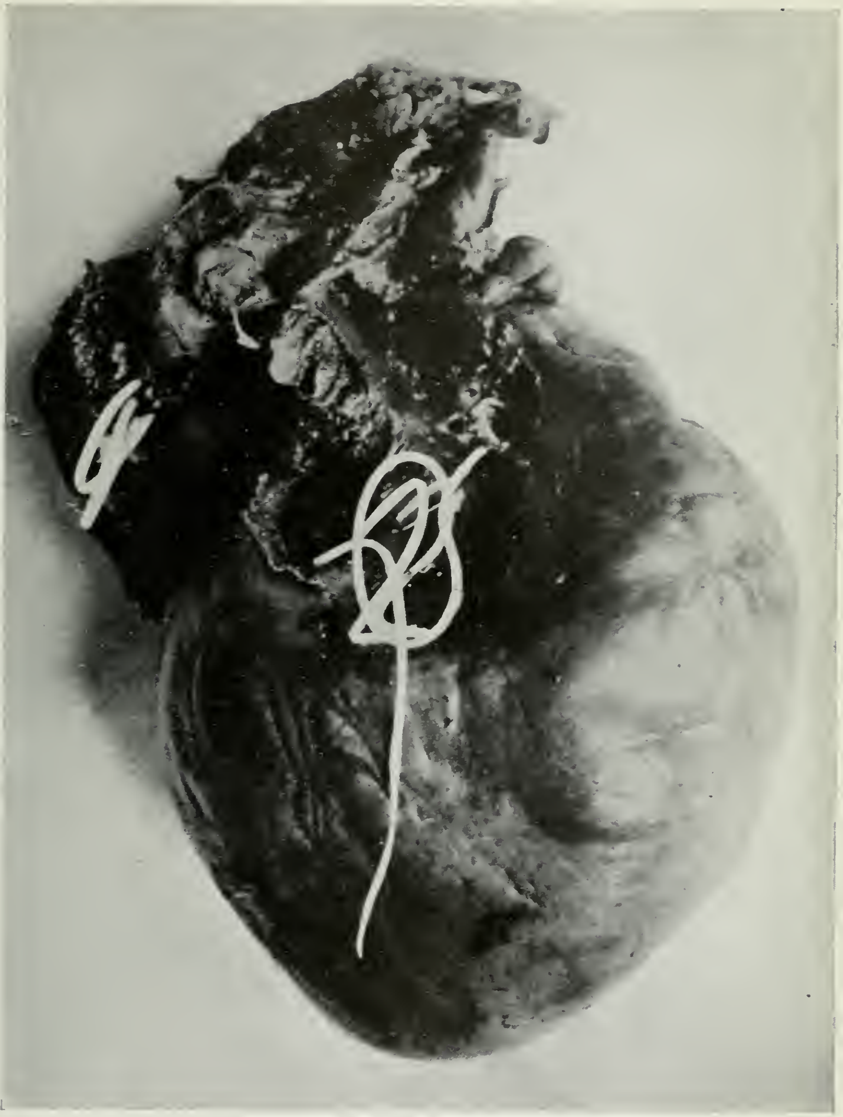
Internal appearance of plicated aorta thirty-three days after operation. Defect in intima to side of plication is due to tear which occurred during mounting, after vessel had been hardened for some days in formalin solution.

FIG. 4.



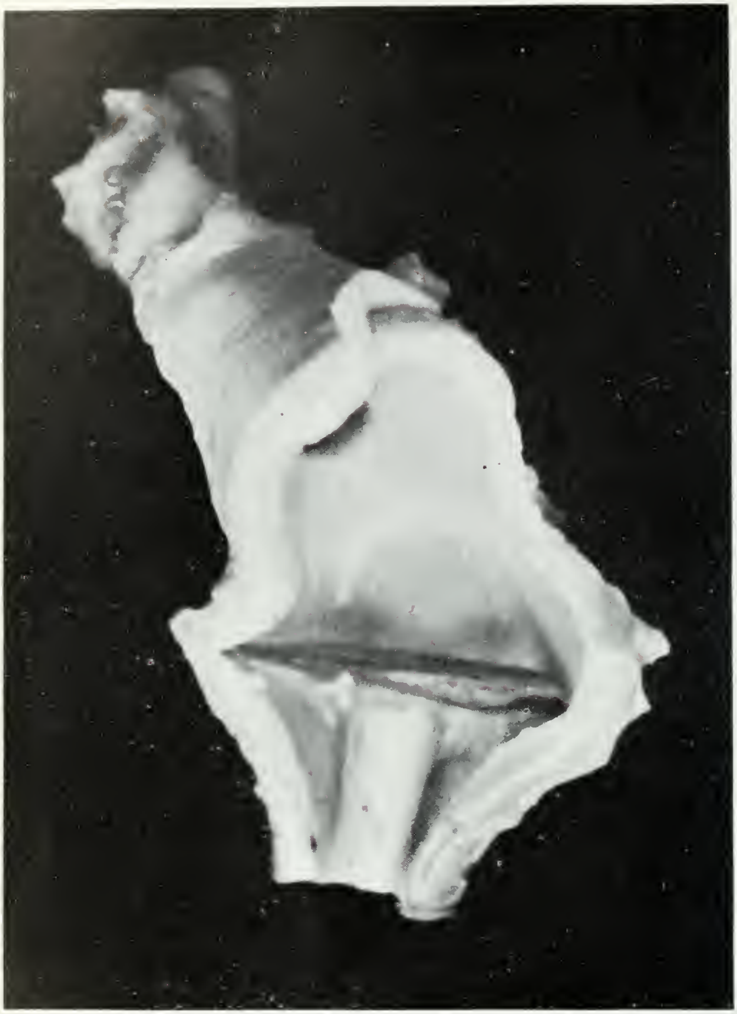
Shows lumen of aorta completely obliterated after three successive plications over same site. Dog died twenty hours after third operation, which at the time of the operation apparently completely occluded the aorta, the death being attributed to the combined effects of heart strain upon a pathologic heart weakened by prolonged filarial parasitism of the gross type. It was also found, at the postmortem, that the apparently complete occlusion, which had been demonstrated at the completion of the operation, had yielded during the twenty hours that the animal had survived, sufficiently to allow a small stream of water to be forced through by injecting the aorta. Apparently this exceedingly small channel was sufficient to permit a reduced circulation to be maintained and to prevent a total ischæmia of the peripheral parts. It is also probable that the remarkable adaptation shown by this animal to a greatly reduced aortic circulation caused by an almost complete atresia of the vessel was due to the development of the collateral circulation following the earlier plications.

Fig. 5.



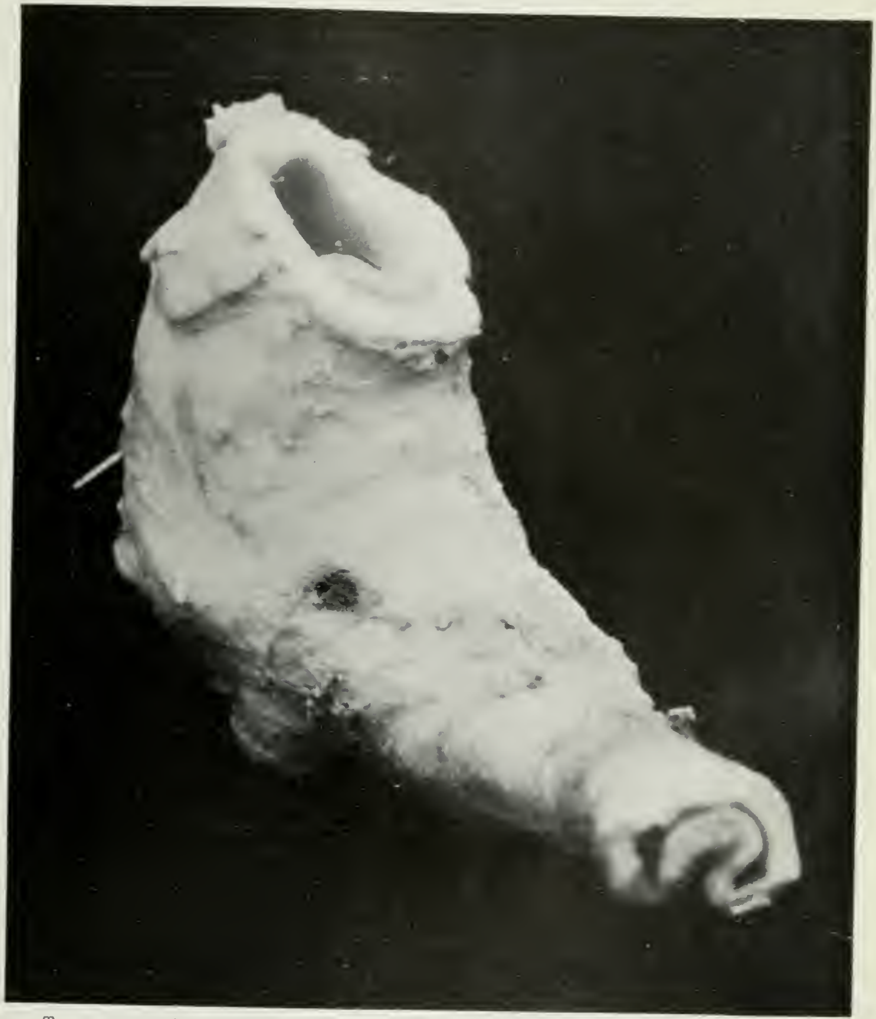
Heart from same dog (Fig. 4), shows filaria protruding from openings.

Fig. 6.



Shows internal appearance of vessel cut across at narrowest part of constriction. Animal killed ninety-seven days after second operation.

FIG. 7



Transverse section of vessel twenty-five days after second operation. Vessel was constricted almost to point of obliteration of pulse. Shows marked infolding of lumen. Compare with Fig. 4, which shows complete obliteration.

an adequate collateral circulation which seemed to be sufficient, when the third stage of plication was reached, to meet the requirements of the tissues beyond the stenosis. Lastly, by the fact that in every case the potential space existing between the infolded mass or plica and the enveloping sheath was never totally obliterated, but remained sufficiently patulous to allow the persistence of a minor circulation which increased in volume in direct ratio to the duration of the survival of the animal; the longer the survival, the larger the space. In other words, there was only a stenosis and never an atresia.

The conditions which are created in the aorta by plication might be compared to those of the pylorus whenever an attempt is made to occlude it in connection with gastroenterostomy, when this is performed for the cure of duodenal ulcer. It has been found that whenever the pylorus is obstructed by plication or plaiting by the methods of Doyen, Delling, Mayo, and others, the plicated segment always stretches and yields in the course of time, no matter how thoroughly it may be infolded upon itself by sutures.[4]

It is quite evident that all stenoses or obstruction caused by the infolding of mucous-lined or endothelial-lined channels, should ultimately yield and stretch sufficiently to allow of free circulation through the plicated segment, if there is sufficient power or *vis a tergo* in front of the constriction to force and direct fluids in the potential space that always exists between the opposed mucous or endothelial surfaces, as the case may be. As long as there is no actual destruction of the endothelial lining in the plicated aorta, or of the epithelium in the pylorus, at the point of constriction, by inflammatory action or other destructive agency, this space must persist, no matter how close the apposition of the surfaces may be, and is always ready to stretch and dilate by the yielding of the opposed elastic walls whenever any fluid is forcibly injected into it.

On the other hand, a stenotic condition is obtained both in the aorta and in the pylorus by the method of plication which

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[4] See Gino Baggio: Sull' Exclusione del piloro coi metodi costrittivi, p. 1055, and F. Nassetti: Esclusioni del piloro, p. 1075 in Clin. Chirurgica, Milano, May 31, 1913, anno 21, No. 5.

may be of therapeutic value, before the obstruction is either partly or entirely overcome. In the aorta, a stenosis could undoubtedly be produced by plication which would reduce the circulation in an aneurismal sac, situated in the proximal and distal side, sufficiently to bring about a cure by the deposition of fibrinous clot. In planning these experiments, in the thoracic aorta, we had contemplated a more radical procedure as the final stage of the stenotic treatment, to be applied to animals that had survived the third plication. It was our intention, after satisfying ourselves of the tolerance of the dogs to this maximum degree of stenosis, to completely divide the aorta in the infolded segment and then seal the stumps by suture or ligature. Thus we had hoped to repeat in the thorax what one of us (Dr. Allen) had accomplished successfully and repeatedly (four times) in the abdominal aorta, viz., the complete section of this vessel below the renals after a series of gradually progressive constrictions with our modification of Dr. Halsted's aluminum bands.

That the aorta can be divided in its thoracic portion below the subclavians, after a sufficient preliminary treatment by the production of gradually increasing stenoses, we believe is quite possible and practicable in young and vigorous animals kept in perfect hygienic conditions. Whether this can be accomplished more certainly and satisfactorily by encircling the aorta with organizable aponeurotic strips (fascia lata) as advocated by Nassetti, or with strips of dogs' aorta, as recently practised by Halsted, is a matter that must be decided by further experimentation.

Sufficient evidence has accumulated to show that in the abdominal aorta the problem of gradual occlusion, especially below the renals, has been solved. We have shown that this occlusion can be made so complete as to permit a total transverse division of the vessel and yet the animal recover permanently from the intervention, and this we have done with constricting aluminum bands. Dr. Halsted had previously demonstrated the possibility of creating marked stenosis in the lower thoracic abdominal aorta by practically the same means though he had not carried the experiment to the point of complete division of the vessel at the stenotic level. He has also shown that the same constriction can be obtained by applying constricting strips of dog aorta. Nassetti has likewise shown that aponeurotic bands can be used successfully to accomplish the same purpose, but thus far a total and absolute atresia of the thoracic aorta, in its upper portion close to the arch, by any of the methods proposed, with permanent recovery of the experimented animals, has not yet been satisfactorily demonstrated.

Our experiments with plication show how nearly we have attained this difficult, but not impossible accomplishment. In the course of these experiments, a large number of segments of the plicated aorta have been preserved with the view of studying the histologic changes that take place in the plicated area and the sutured aortic walls. We had hoped to demonstrate in the course of time, that the endothelial surfaces brought in apposition by the plication would ultimately fuse and blend, through cell proliferation. In this way the potential space, to which we have so frequently referred, as existing between the endothelial surface of the plica and of the sheath, would be totally obliterated, just as the lumen of an artery is obliterated by plastic and proliferative endarteritis when it is constricted with just sufficient force to arrest the circulation in the vessel without crushing its coats. If we may correctly interpret the specimens that we have thus far obtained, it would appear that the constriction obtained by parietal suturing sufficient to infold the vessel walls, is not capable of inducing sufficient trauma to bring about an adhesive or obliterative endarteritis in the infolded segment. Dr. Halsted has also shown, by his notable experiments, in constricting the abdominal aorta with his aluminum bands, that the aortic walls may, in some cases, be infolded to a sufficient extent to narrow the lumen of the vessel short of a total occlusion for almost an indefinite length of time without the production of an obliterative endarteritis. This, however, is an exceptional result when metallic bands or circular constricting agents are used. Usually the traumatism caused by the constriction leads either to an obliteration of the vessel by ulcerative changes, or by the atrophy of the wall, which brings the constricting band in contact with the intima or with the blood stream which in turn is the cause of an obliterative endarteritis. In the abdominal aorta, the dangers of excessive constriction with secondary ulceration or atrophic changes are guarded by the strong encapsulating rings which surround the constricted areas, a protection which is lacking in the thoracic aorta, especially in its upper segment.

In further confirmation of the preceding facts, our observations upon the sutured aorta, in the second and third operations, have shown a gradual tendency toward the reëstablishment of the lumen. This has been principally due to a gradual relaxation and yielding of the sutured portion, though it seemed, in some cases, to be partially due to a compensatory dilatation of the remaining portions of the vessel wall at this point. This tendency was greater the longer the interval between the operations, and was decidedly greater after the second than after the first operation. About 65 per cent. of the cases maintained the primary degree of constriction unchanged for a period averaging about three weeks. Probably less than half this percentage (28 to 30) retained the original constriction after the second operation for the same period of time.

It is quite evident from all our observations that, if it is at all healthy, the heart and all the forces of the organism are set to work to remove the obstacle in the main channel of the circulation, thus defeating, in the course of time, the most carefully executed plans of the operator. Thus far, no animal has survived a third plication, which caused a total obliteration of the lumen, or which would permit of a complete dry section of the aorta through the plicated segment. But the capacity of the heart to adjust itself to an extreme degree of aortic stenosis, when this is gradually accomplished, is indeed remarkable and most noteworthy, as shown in the animals from which the specimens were removed which have furnished our illustrations.

The applications which we have thought might be made of the foregoing experimental facts in human surgery, are:

The practicability of blocking the thoracic aorta sufficiently to favor the gradual deposition of the clot in an aneurism situated in front or behind the plication, and to obtain this stenosis or constriction in a safer and more certain way than can be accomplished by ligatures or bands of metal or other material, which constrict the vessel circumferentially and over a comparatively narrow area.

Second: To reduce the calibre of the fusiform, cylindrical, or saccular aneurisms, that are otherwise inoperable, by reinforcing their walls by plication.

In addition to plication, we have thought of the possibility of strengthening and supporting the walls of rapidly expanding aneurisms, which are otherwise inoperable, by wrapping them at the weakest points with free flaps of fascia (aponeurotic grafts), as the most available material, which we would suture to the sac. In other places this is a good grafting material, but we have not yet sufficiently tried it to permit us to express a definite judgment as to its value; but this is an afterthought which has only been suggested by the recent work of Nassetti and of Halsted. Thus far the method of exclusion or short circuiting, applied to aneurismal areas situated in the aortic tract, by means of direct anastomotic connections or with transplanted vessels, provisional or glass tubes, by the ingenious procedures devised by Carrel and more recently by Jeger and Schuppelmann in their experimental work, has no application to surgery. No method of anastomosis can provide for the maintenance of the indispensable cerebral circulation whenever the carotid bearing section of the arch is excluded from this vessel.

In the abdominal aortic tract, the possibility of transplanting the great visceral trunks, either by the method of Carrel, or by the very ingenious and successful technic of Jeger and his associates, which has led to such remarkable results in the transplantation of the renal vessels, must be recognized as an experimental fact which may soon have very decided application in the surgery of abdominal aneurism. This new development in the technic will permit of the obliteration of an aneurismal sac by aneurismorrhaphy or its extirpation, provided the great visceral arteries (cœliac axis, the mesenteric arteries, the renals) which spring from these sacs, may be safely transplanted to another level of the main trunk above or below the obliterated sac.

In the light of our present knowledge, the direct intervention of surgery in the treatment of aortic aneurism must be restricted to *explorations,* both abdominal and thoracic, which will permit us to ascertain the relations of the aneurismal sac to the parent vessel. In a certain number of cases of saccular aneurism, it may be posible to obliterate the communications leading from the sac to the artery, by the method of intrasaccular suture. In the majority of cases the operation will have to be limited to methods which will simply tend to reduce the circulation in the sac and thus favor the coagulation of its contents. This may be accomplished by any of the classical methods of wiring or by narrowing the lumen of the vessel immediately above or below the aneurism, by the use of constricting agents, whether metallic (Halsted or Matas-Allen aluminum bands), or tissue strips (aponeurosis, Nassetti; aortic, Halsted), or by suture methods, such as the plicating procedure which has been the special object of the investigations which Dr. Allen and I have conducted in the laboratory of experimental surgery of the Tulane University and which are possibly more feasible in the human aorta than in that of the dog.

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SOME ANATOMIC AND PHYSIOLOGIC PRINCIPLES CONCERNING PYLORIC ULCER.

BY G. PAUL LAROQUE, M.D.,

OF RICHMOND, VA.

THE inclination of the present day anatomist is to present his subject to us based on its embryology and biology rather than upon the mere gross appearance. This has caused changes in nomenclature, shifting of boundary lines and in some instances changes of description when contrasted with those of older teachers.

When carefully studied in relation to development, blood and nerve supply, lymphatic drainage and especially in connection with physiology and pathology, there is ample justification for reconsideration of nomenclature in many areas. This is especially true of the alimentary canal.

Using the old nomenclature, the stomach and that portion of the duodenum as far as the point of entrance of the common duct (derived from the foregut) is functionally sharply delimited from the small intestine and proximal half of the large bowel (midgut derivatives), and this in turn has functions different from the part of the bowel beyond the splenic flexure. The abdominal part of the alimentary canal having its origin from the foregut, namely the stomach and proximal duodenum, is supplied with blood solely through derivatives of the cœliac axis; beyond this to the splenic flexure (midgut) solely through the superior mesenteric and beyond the splenic flexure (hind-gut) to the lower third, of the rectum, through the inferior mesenteric vessels. Physiologically the foregut derivatives prepare food for digestion, the midgut derivatives further digest and absorb substances, the hind-gut derivatives expel the residue. Pathologically, evidences of delimitation of these three areas are also seen.

There are several important considerations with reference to the anatomy and physiology of the stomach and duodenum in relation to ulcer. The point of the duodenum above the common duct, namely about the first four inches, is in reality a part of the stomach and should be so considered. This part of the alimentary tube together with the stomach proper is derived from the foregut; has the same blood supply as the rest of the stomach, namely through the cœliac axis; the same nerve supply through the pneumogastrics, and sympathetics, and the same lymphatic drainage. Its mucous membrane is thin and granular, it contains no valvulæ conniventes, and does contain Brunner's glands which are identical in structure with the hydrochloric acid glands of the stomach. Its functions and diseases are those of the pyloric region of the stomach. The proximal duodenum does not exhibit peristalsis and in this respect is like the cardiac end of the stomach. Like the cardiac end also it serves as a mixing chamber for the food and digestive secretions, being acted upon by respiratory movements of the diaphragm through the liver.

A new nomenclature might designate various parts of the stomach as follows: It is divided into two parts, the left or cardiac portion and the right or pyloric portion, by a line passing from the incisura angularis on the lesser curvature to a point opposite on the greater curvature. The cardiac portion would then be subdivided into the cardiac fundus, cardiac sac, or cardiac chamber, and the body of the stomach. The pyloric portion would be subdivided into the pyloric vestibule, pyloric canal, and pyloric fundus, pyloric sac, or pyloric chamber, at present designated as the proximal duodenum (Mayo).

The fundus and body of the stomach are supplied by the gastric and splenic arteries, while the whole pyloric portion, including the pyloric chamber down to the common duct, is supplied by the hepatic artery through its pyloric and gastroduodenal branches. These are all derivatives of the cœliac axis. The small intestine beyond the common duct gets all of its blood supply through the superior mesenteric arteries. Even the inferior pancreaticoduodenal branch of this vessel does not supply any part of the tube above the common duct.

The entire pylorus and duodenum when considered together are arranged grossly in the shape of an ‘ S ’ placed transversely. This shape is comparable with that of the S-trap employed by plumbers and allows the acid chyme, bile, and pancreatic fluid to accumulate in the pyloric chamber between the sphincter muscle and the common duct. That accumulation actually occurs is shown by the fact that this part of the pylorus is always stained with bile after death and in comparison with the remaining part of the small intestine is much dilated. X-ray pictures taken after the administration of bismuth show an accumulation of bismuth in this area designated by radiographers the " pyloric cap." The S-shaped arrangement also prevents regurgitation of gas and fluid from the small intestines into the stomach. The ease with which patients under certain circumstances vomit large quantities of bile and alkaline fluid shows inadequacy of the pyloric sphincter as a partition.

The upper margin of the entire stomach along the lesser curvature and for two inches beyond the pyloric sphincter, is suspended from the liver by the gastrohepatic omentum, the free edge of which is called the duodeno-hepatic ligament. Free mobility of the stomach and proximal duodenum is thus permitted. Beyond the duodeno-hepatic ligament and especially beyond the opening of the common duct, the duodenum is securely fixed in position, behind the peritoneum.

Chronic ulcers of the pyloric region are found just twice as commonly in that portion just distal to the pyloric sphincter as they are in the part of the stomach on the proximal side of the sphincter. In 621 cases Mayo found 64½ per cent. on the duodenal side and 32½ per cent. on the gastric side of the pyloric sphincter, 3 per cent. were found on both sides. By all odds the greatest number (90 per cent.) of ulcers at present designated duodenal in location, are found in the first two inches of the duodenal portion of the pylorus and for this there are definite anatomic reasons. This location corresponds to the highest point of the pyloric region, the fundus.

The fundus of all organs is notoriously deficient in blood supply as compared to other parts of the organ. Witness for example the gall-bladder, the urinary bladder, the uterus, and even the fundus of the cardiac end of the stomach. Mayo's anæmic spot is located in the fundus of the pylorus and Wilkie, from a study of 40 specimens with reference to the arterial supply of the pyloric area, found the first two inches of the duodenal portion of the pylorus markedly deficient in blood supply as compared with the rest of the region. This investigator has shown that the first two inches of the duodenal portion of the pylorus is supplied by the supraduodenal artery which though usually a branch of the gastroduodenal, sometimes arises from the hepatic and other arteries in the neighborhood. The anastomosis of the supraduodenal with the surrounding arteries is very imperfect and often this is a true end artery with no anastomosis. The first two inches of the duodenal portion of the pylorus is therefore designated as the critical area on account of its deficiency of blood supply and its notoriously common seat for ulcer formation.

Moreover, the first two inches of the proximal duodenum is freely movable whereas the area beyond is comparatively fixed. It therefore represents the junction of a fixed and movable portion. The tendency for infection to be located at such a junction is strikingly manifested by the localization of tuberculosis of the spine at the dorsolumbar junction. Moreover in the pylorus this critical area represents the junction of two curves, the ascending and the descending portions of the proximal duodenum. The tendency for localization of infection at the meeting place of two curves is exhibited by other structures throughout the body.

The dome of this region is commonly the point affected and the dome of all hollow organs is relatively poorly supplied with blood. The slight local anæmia incident to vascular sclerosis may account for the greater tendency to ulcer in men as compared to women. Ulcer is in reality local circumscribed gangrene and men are more frequently the victims of gangrene than are women though no more commonly the soil for infection. As to whether the slightly higher location of the pylorus fundus in men (Mayo) or the slightly greater tendency to V-shape of the duodenum in women (Piersol) can account for the greater frequency of ulcer in men remains yet to be determined.

There are anatomic conditions which make possible the belief which I am about to express for perhaps the first time, that ulcer of the gastric side of the pylorus sphincter is perhaps a later development representing an extension of infection and that perhaps the lesion begins as an inflammatory process on the duodenal side of this sphincter, in the part of least defence, the fundus of the pylorus.

Anatomic conditions in women may or may not be less favorable to the development of ulcer on the duodenal side, but infection may occur and being resisted and its symptoms borne, may progress through the lymphatic vessels in the mucous and submucous coats of the pylorus to the gastric side of the sphincter where it is found at a later period on the table or at autopsy. This may account for the older figures from autopsy findings showing greater frequency of gastric than duodenal ulcer in women than in men, though doubtless as Mayo suggests, many cases in reality of duodenal ulcer, were called gastric on account of failure accurately to locate the ulcer in relation to the pyloric sphincter. This continuity of lymphatic vessels in the mucous and submucous coats of the duodenum and stomach may also account for those ulcers which are continuous across the sphincter on both sides.

Any study based on sex incidence of diseases of the digestive apparatus save those incident or secondary to pregnancy or lesions of the generative organs, gives little or no information as to the specific primary exciting cause. Men, as compared to women, are notoriously intolerant to pain and to infection. Women have both an inherited and an acquired resistance to infection. Phylogenetically we should expect processes of infection and pain to pursue a more mild clinical course, and be more easily resisted by females than by males.

More men than women are operated upon for pyloric ulcer but there is no reason to believe that the bacteria of the duodenum and bile tract are more numerous or of greater virulence in men than in women. Perhaps the male intolerance to both pain and infection causes us, through seeking operative interference, to secure the preventive treatment of at least gall-stones and perhaps of the extension of ulcer or its cause from the duodenal to the gastric side of the pylorus.

Pyloric ulcer is found at operation more frequently in men than in women, whereas chronic appendicitis and biliary calculi are more common in women. Appendicitis and bile tract infection are much more frequent than pyloric ulcer. For acute abdominal diseases, barring gynæcologic affections, more males than females are operated upon. In females, chronic lesions are found more commonly. Pyloric ulcer even though chronic, certainly must be more constantly and positively painful and productive of acute indigestion than are attenuated chronic infections of the bile tract and gall-bladder calculi.

THE RELATIONSHIP BETWEEN GASTRIC AND PANCREATIC CARCINOMA.*

BY EDWARD A. SCHUMANN, M.D.,
OF PHILADELPHIA.

Observation of a case of carcinoma of the stomach, which had invaded the pancreas, eventually causing leakage of pancreatic secretion with subsequent generalized fat necrosis, has led the writer into a survey of the literature of this subject with the result that there is found a comparatively large group of recorded cases, wherein the combined symptomatology of a gastric carcinoma with extension to the pancreas has occasioned a peculiar, baffling train of events, presenting great diagnostic difficulties and uncertain of explanation even when the diagnosis is assured by laparotomy or autopsy.

The history of the case prompting this report is as follows:

Mrs. X, forty-nine years, III-para, a woman of excellent heredity and a negative previous medical history was first seen in consultation June, 1911, when she complained of some acid indigestion with œdema of the feet.

She was a very large, robust woman, who suffered from some distress and eructation after eating, but with no nausea or vomiting.

Examination of the chest and abdomen proved entirely negative, there was no demonstrable disease of the nervous system, the urine was normal, the hemoglobin 95 per cent. A short course of antacid treatment with regulation of the diet promptly relieved the symptoms.

In Nov., 1911, the patient suffered from an acute attack of pain in the abdomen, well localized in the right hypochondrium, the pain coming on without apparent cause and during what seemed to be normal health. She was under the care of Dr. J. O. Tilton, of Lexington, Mass., and in spite of all medical treatment failed to improve. The pain continued, the patient became jaundiced, constipated and a small mass developed on the right side in the gall-bladder region.

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* Read before the Philadelphia Academy of Surgery, March 3, 1913.

Dec. 6, 1911, the writer was called into consultation and the following conditions were noted:

A well nourished woman, suffering a moderate degree of abdominal pain but not exhibiting any evidences of shock. She was moderately jaundiced, the sclera deeply stained, the tongue was pale and flabby, the pulse full and strong. There was no history of sweats but occasional slight chills were noted; the temperature rose from normal in the morning to 100° F. at night, there was some degree of nausea and distaste for food, but no vomiting. Pain was considerably increased immediately after eating solid food. The heart and lungs proved negative to physical examination, the blood pressure was 130 mm.

The abdomen was slightly distended but soft and presented a small rounded mass in the right nipple line, just below the costal margin; the mass moved synchronously with the respiratory excursion, was semi-fluctuating in character and was very tender, pain on palpation was distinctly transmitted to the left lumbar region, high up.

The stomach could be indefinitely outlined and revealed no evidence of gross change.

The pelvic organs were normal, the urine was bile-stained, negative for sugar, albumin and casts. There was no fat present in the somewhat pale stool. After further consultation with Dr. Tilton and Dr. E. H. Stevens, of Cambridge, a diagnosis of cholelithiasis was made and the patient removed to the Copp Hospital for operation. It may be noted that she walked without discomfort down a flight of stairs to an automobile and rode six miles to the hospital where she mounted another flight of stairs without exhaustion.

Under ether anæsthesia, the gall-bladder was exposed by an incision parallel to the costal margin. Upon opening the peritoneum the palpable mass was found to consist of rolled up omentum, densely adherent and undergoing fat necrosis. The entire upper segment of the abdomen showed extensive fat necrosis and the structures were so densely adherent that relations were indistinguishable. The gall-bladder was collapsed and pale and contained no stones. On account of the violent hemorrhage encountered when adhesions were separated, it was impossible to examine the pancreas in detail, but it was found hard and indurated and considerably enlarged. The stomach was normal in size and presented a small thickened area at the pylorus which was buried in adhesions.

Free drainage was instituted with no attempt at any radical measures which were obviously impossible in the face of the fat necrosis and severe hemorrhage, and the patient returned to bed.

She improved slowly for ten days, with free drainage of seropurulent fluid containing pancreatic ferments, and with marked relief of pain and tenderness. Then, suddenly the temperature rose to 104° F., the abdomen became enormously distended and the patient died in collapse.

The autopsy performed by Dr. A. F. Boretti showed the parietal peritoneum thickly covered with granular and stringy fibrous exudate matting together every loop of intestine and forming a mass of adhesions around stomach and in right hypochondrium. Abdominal cavity contains (estimated) 1500 c.c. of turbid blood-stained fluid with a marked odor of formalin. Pelvic organs not remarkable. In right hypochondrium, in region corresponding to abdominal wound, several structures are firmly matted together and cannot be separated without tearing. The liver is enlarged, all its surfaces adherent to the surrounding peritoneal layers. The gall-bladder is covered with fibrous adhesions but contains no stones and is practically empty. The stomach feels thickened in its pyloric portion. The spleen is greatly enlarged, soft and held down in its fossa by soft, fibrinous adhesions. Because of the very marked adhesions all attempts at dissecting and following out the branches of the portal vein and bile ducts are unsuccessful. The intestines are removed as far as the duodenum and are not remarkable except as described. Duodenum opened *in situ,* shows no gross change. Stomach shows, bordering on the pyloric rim, and located in its posterior surface, a round, conical ulceration measuring 2 cm. in diameter by about 1 cm. in depth with an eroded, granular, grayish-red floor, the substance around it being thickened, on section presenting a grayish, nodular appearance and firm consistence.

This thickened portion tapers off gradually into the surrounding stomach wall, the mucosa of which has a granular, atrophic appearance.

Pancreas.—Is firmly adherent to the posterior abdominal wall and to the surrounding structures; the head and tail are normal as is the lower part of the body. In the upper part of the body, near its middle, is a mass the size of a hen's egg showing on section, the same grayish, nodular appearance noticed in the above described area in the stomach. On manipulating the structures some purulent material can be expressed from around the nodules. The nodules deeply infiltrate the normal pancreatic substance. The duct is patent as far as can be followed toward the head.

Liver.—Is large and voluminous, on section presents a grayish green, pale appearance, the substance somewhat greasy to the touch. Near the beginning of the middle lobe and starting in the hilum, around one of the large branches of the left portal vein, the periportal structures are greatly thickened, of a whitish, nodular appearance, a large number of droplets of purulent material being expressed from the spaces around the vein. The vein itself shows roughening and thickening of the intima, which is covered by a thin film of whitish material. The periportal process infiltrates the liver substance bordering on it.

Gall-bladder.—Not remarkable except as before described.

Spleen.—Very large, about twice normal size. Capsule tense, of livid violet hue. On section substance is very soft and diffluent, follicles appear as irregular grayish bodies averaging 2 mm. Trabeculæ not visible.

Kidneys.—Both kidneys show normal amount of perinephritic fat. Capsule strips with slight difficulty leaving a very finely granular surface. On section somewhat pale. Pelvis and ureters normal.

Aorta.—Shows a few yellowish elevated plaques in its lower part.

Anatomical Diagnosis.—Carcinoma of the stomach with ulceration. Carcinoma of the body of the pancreas. Purulent infection of periportal spaces in one branch of vein in liver. General acute fibrino-purulent peritonitis with extensive fat necrosis. Chronic adhesive peritonitis in right hypochondrium and around pancreas. Operation wound and trochar puncture.

Microscopical Examination.—Sections taken from affected regions of stomach and pancreas show a markedly infiltrating carcinoma, in some places it being of an almost pure medullary type, while in others the fibrous stroma is much more marked. Necrotic areas are very abundant, abscess cavities are numerous, polymorphonuclear leucocytes are seen in large numbers, being also found infiltrating the stroma around these areas. The pancreatic substance shows a fairly well marked increase of fibrous tissue between the acini.

Diagnosis: Carcinoma of stomach, infiltrating pancreas and surrounding lymph nodes. Chronic interstitial pancreatitis.

Liver: Section shows very marked fatty infiltration around central veins.

Sinusoids contain many endothelial leucocytes.

Spleen: Follicular structure is almost obliterated. Sinuses distended and filled with fine granular coagulum and containing many endothelial cells and several polymorphonuclear leucocytes. Blood pigment abundant in these cells. Capillaries congested.

Diagnosis: Acute splenic tumor (acute œdema, congestion and hyperplasia).

A summary of the foregoing case history, brings out the rather surprising fact that there were present four of the more grave affections of the upper abdomen existing simultaneously, three of them presumably superimposed upon the fourth.

The primary focus of disease was in all probability the gastric ulcer, which later suffered carcinomatous degeneration, the carcinoma subsequently becoming secondary in the pancreas. This latter organ under the irritating influence of the carcinoma became the seat of a chronic interstitial inflammation.

In a very careful study of the patient, none of these four lesions was suspected, except the pancreatitis which was considered because of the persistent pain in the left lumbar region.

That such profound tissue change could proceed without any manifestation, for a period evidently extending over several months and culminating finally in an attack characterized only by moderate abdominal pain, jaundice and slight fever, is worthy of attention.

There are on record several cases highly suggestive of the same condition, and a comparative study of these case histories leads one to the conclusion that there must exist some interaction of the nervous and chemical relations between the stomach and pancreas by which the effects of disease in one organ are, in a measure, counteracted by a compensatory or sympathetic hyperactivity of its neighbor.

A few typical case reports from the literature follow:

Bode[1] cites one case in a woman of 33 years, who complained for a few weeks of a feeling of abdominal fulness, some loss of flesh and strength. She developed jaundice, enlargement of the liver and retention of urine. On examination the gall-bladder was enlarged and tender, there was slight fever, the urine contained bile but was free from albumin and sugar.

Under a diagnosis of gall-stones, operation was performed; the gall-bladder was found distended with bile, its ducts obstructed from the outside, no stones or adhesions present.

The head of the pancreas was greatly enlarged by a firm, smooth tumor which obstructed the common bile duct at the ampulla. Cholecystduodenostomy was done and the patient discharged upon convalescence.

One year later she again presented herself, much emaciated and with a tumor visible at the site of operation. On section there was found a large, nodular adherent carcinoma of the pancreas firmly adherent to the papilla.

In this case it is doubtful whether a primary carcinoma was present or whether the primary focus was in the ampulla of Vater with secondary development in the pancreas. Bode thinks it possible that the carcinoma may have developed in an old interstitial pancreatitis.

Syms[2] reports an interesting case in a male twenty-four years of age. For one year there were noticed slight stomach symptoms; three months before these symptoms had grown more severe and were attended with some nausea and occasional vomiting, jaundice developed, with pale stools, the urine bile stained and there was slight fever. On examination there was found a rigid abdomen with tenderness in the epigastrium and marked pain in the upper left lumbar region. Upon operation the gall-bladder was found distended but there was no disease of the biliary system. A firm, nodular mass was attached to the posterior wall of the stomach, extending from behind the duodenum well across the posterior gastric wall. The gall-bladder was drained, but the patient died in four days.

Autopsy showed the gall-bladder and ducts free from disease. There was present a large carcinoma involving the pancreas, the posterior wall of the stomach and the suprarenal on the right side. The jaundice was due to the compression of the duct.

Körte[3] reports a case in a woman of forty-one, who for two years had had indefinite symptoms referred to the stomach, with slight loss of weight. She was suddenly seized with severe pain in the upper abdomen and breast, vomiting and diarrhœa. The abdomen was distended; at the epigastrium, above the umbilicus and a little to the left was a tender, fist-sized tumor, which did not move with respiration and presented a small area of fluctuation. On operation a large abscess was found between the layers of the gastrocolic omentum and attached to the stomach and colon. Its contents were thick pus, particles of fat and necrotic tissue. The wound was drained, the patient dying two months after operation. Autopsy showed a mass of adhesions in the upper abdomen and a well advanced carcinoma of the pylorus, to which is firmly attached the head of the pancreas, which is penetrated by the carcinoma.

It has been proved beyond doubt that a close nervous and chemical relationship exists between the stomach and the pancreas and that if the sequence of this mechanism be altered by disease, changes may result in the function of either or both organs.

According to Howell[4] the order of digestive stimuli in the stomach and pancreas is as follows: the acid of the gastric juice, upon reaching the duodenum produces the material called secretin, which is in turn absorbed by the blood and carried to the pancreas where it stimulates that organ into activity. There is also present and active a nervous mechanism contained in the secretory fibres of the splanchnic and the vagus.

It is perfectly reasonable to suppose that in certain cases of gastro-pancreatic disease the secretory activity of the pancreas may be excessively stimulated by the presence of an irritating neoplasm and may reflexly cause excessive secretion and hence increased peristaltic action on the part of a stomach invaded by carcinoma. The greater secretion of gastric juice, with the increased peristalsis may readily counteract the symptomatic effect of a well advanced carcinoma of that organ. It is some such interaction of function that, in the opinion of the writer, makes possible the clinical expression of the cases under discussion.

Secondary invasion of the pancreas in abdominal carcinoma is not a common occurrence. Willigk[5] in 467 autopsies upon patients dying of carcinoma, found the pancreas involved in 29.

Biach[6] found in the Wiener allgemeinen Krankenhaus in 1270 autopsies in cancer cases that the pancreas was involved in 22. In the Rudolphspital one case of pancreatic cancer was noted in 221 cases dying from this form of malignant tumor.

As to the location of the growth in the gland itself, the head is most frequently involved. Mailand[7] found in 57 cases, the head as the seat of disease in 35, the tail 1, the body 2 and 19 were diffuse throughout the entire organ.

Morallie[8] found in 113 cases of pancreatic cancer, the head affected in 82, the tail seldom involved.

Of the histologic varieties of carcinoma, the glandular type is the most frequent, closely followed by scirrhus.

A point of interest in this connection is whether the primary tumor in the pancreas is really of pancreatic origin, or whether many such growths are not secondary to an overlooked focus in the pylorus or duodenum.

Oliviere[9] in a very careful study, holds that a neoplasm apparently primary in the pancreas may have had its origin in the duodenum, and that only the most painstaking microscopic study can differentiate the two.

Fähndruch[10] in an inaugural dissertation reports several cases wherein apparently primary pancreatic cancers had their true source in a small tumor in the gastric mucosa.

The conclusions gathered from a review of the foregoing are: that secondary invasion of the pancreas is a somewhat infrequent sequel of pyloric or duodenal carcinoma and that in a certain group of cases, where the pancreas is attacked early in the course of the disease, there may arise a mutual functional compensation between stomach and pancreas, which permits both organs to satisfactorily perform their duties, with a decided absence of symptoms of disease of either, even though there may be extensive destruction of tissue.

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SUBDIAPHRAGMATIC ABSCESS.*

BY DUNCAN L. DESPARD, M.D.,
OF PHILADELPHIA.

A SUBPHRENIC abscess may be defined as a localized collection of pus situated immediately below, and in contact with, the diaphragm, or only separated from it by the peritoneum.

In order to better understand the localization of pus in this region a brief review of the anatomical relations of the viscera which occupy it will be of assistance.

If the organs are removed from the abdominal cavity, leaving only the parietal peritoneum, it will be seen that the reflections of peritoneum entering into the formation of the lateral ligaments of the liver, the gastrohepatic omentum, the gastrosplenic omentum, the gastrophrenic and the costocolic ligaments, divide the diaphragmatic area into an upper anterior and a lower posterior part. The space above this transverse chain is divided into right and left anterior spaces, both being intraperitoneal, by the falciform and round ligaments of the liver, while the part below it is divided by the reflection of the peritoneum to the duodenum and the hepatic vessels into a right and left posterior intraperitoneal space, both lying above the transverse mesocolon, but communicating with each other through the foramen of Winslow; the former being known as the subhepatic fossa or the right renal pouch, and the latter, as the cavity of the lesser peritoneum.

H. L. Barnard, in his admirable paper on this subject, pointed out that in the presence of infection the viscera of the upper abdomen would adhere to each other and to the abdominal wall in such a manner as to form the lower and anterior limits of these spaces in which pus could accumulate, forming discrete abscesses, separated from each other and from the rest of the abdominal cavity.

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The right anterior intraperitoneal space is bounded, behind, by the right lateral and coronary ligaments of the liver, below, by the upper surface of the right lobe of the liver, the falciform ligament is to the left, while its lower anterior limits are often formed by adhesions between the margin of the liver and the anterior abdominal wall; however, if the infection arises below, as from an anterior perforating gastric ulcer, the lower boundaries of the abscess are formed by adhesion between the surface of the stomach, colon or great omentum to the anterior abdominal wall. The left anterior intraperitoneal space is limited, above, by the diaphragm, behind is the left lateral ligament and the diaphragm, to the right by the falciform ligament, the reflections of the peritoneum entering into the formation of the gastrohepatic and gastrosplenic omentum, below and to the right, by the stomach, which, together with the great omentum becomes adherent to the anterior abdominal wall, shutting the abscess off from the peritoneal cavity below, while to the left is the spleen and the left abdominal wall.

The right posterior intraperitoneal space, or the subhepatic fossa, is overhung by the liver and the gall-bladder, which form its anterior wall behind, it is limited above by the right lateral and coronary ligaments, while, posteriorly is the right crus of the diaphragm and the right kidney; to the left is the duodenum, the bile ducts, vessel to the liver, and the foramen of Winslow, through which this space communicates with the lesser peritoneal cavity; while along the lower margin of the left lobe of the liver in front and the anterior surface of the stomach a narrow communication exists with the left anterior intraperitoneal space. On the right side infection may find its way around the right ligament, as well as around the anterior margin of the liver to the right anterior peritoneal space and below it communicate with the right lumbar fossæ. The left posterior intraperitoneal space, or the lesser peritoneal cavity, rests upon the left crus of the diaphragm and the pancreas; to the left is the spleen, to the front is the liver, the lesser omentum, and the posterior wall of the stomach; to the right are the duodenal vessels, bile ducts, and foramen of Winslow.

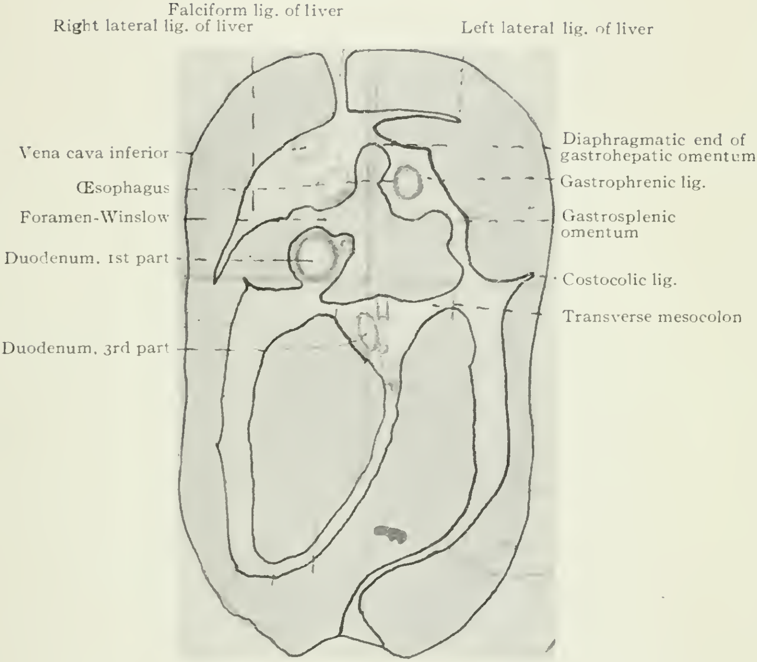
An extraperitoneal subphrenic abscess is formed on either side by infection of the retroperitoneal tissues. On the right side the pus finds its way between the two layers of the lateral ligaments and the coronary ligament, thence forward to the falciform, often as far as the umbilicus, while on the left side the pus dissects up the peritoneum from the surface of the diaphragm in order to make room for the abscess between them.

Etiology.—Subdiaphragmatic abscesses may be, but are seldom, primary. They usually follow some lesion producing direct contamination of the peritoneum in this situation, or by the extension of a suppurative process distally situated, either by contiguity, continuity, through the lymphatic vessels or through the blood currents.

The most frequent cause is probably perforation of gastric or duodenal ulcers, while infectious processes occurring in the abdominal or thoracic organs are common, among which, in the order of frequency, are appendicitis, suppurative conditions of the gall-bladder, liver, pelvic organs, thorax, and spleen. They occur in septicæmia and pyæmia. In one of the cases reported here it was tubercular, secondary to a thoracic lesion.

Symptoms.—The previous history is usually that of the condition which ultimately gives rise to the abscess. If it originates from a gastric or duodenal ulcer, a history of digestive disturbance, pain associated with the taking of food, etc., would likely be obtained. The onset may be sudden or insidious; if intraperitoneal it is apt to be acute and violent when due to a perforating ulcer, but not always, as it may be subacute when the ulcer perforates through a small opening. During the course of a septic condition the formation of the abscesses may be largely masked by the preponderance of

FIG 1.



After Delépine, showing lines along which the peritoneum leaves the abdominal wall to invest the viscera. (From Gray's Anatomy, page 1269, Fig. 876, 17th edition. By Da Costa and Spitzka.)

these processes. The amount and character of pain are variable; it is generally present early, at the site where the abscess ultimately forms.

Tenderness and rigidity accompany the onset of a local peritonitis, but as the abscesses become walled off they lessen to some extent. The temperature in these cases, if the abscess is well localized, may be very slight, but sooner or later it becomes septic in character, and may be accompanied with rigors and sweats. The patients become anæmic, lose weight and strength rapidly; often their only complaint is extreme weakness. Leucocytosis is always present, but varies with the degree of the infection and the resistence of the individual. In about two-thirds of the cases an abdominal mass can be detected; it is dull to percussion, tender and firm if due to inflammatory tissue; while signs of fluctuation, slighter tenderness; and sometimes tympany is present, if the pus is due to a gas-producing organism. Displacement of the liver depends upon the formation of a line of adhesion between the liver and the anterior abdominal wall, which is usually the case, when the infection progresses from the posterior part of the upper surface of the liver to its anterior margin, in this case the liver does not descend with respiration.

As pus accumulates between the liver and the diaphragm the lung is displaced upward and more or less compressed, thus giving rise to altered physical signs at the right base, and sometimes accompanied with the plastic or serous pleurisy or a localized bronchitis. However, if an abscess is situated in the right intraperitoneal space and the line of adhesions does not form between the liver and the abdominal wall, or the abscess originates below the liver margin it would assume a triangular shape which would extend from the ensiform process to the umbilicus by a line convex to the left representing the falciform ligament and from there to the right costal margin. In an abscess situated in the corresponding space on the left side, the mass would have its right boundary convexed toward the right, while its left boundary would extend from the umbilicus to the left costal margin, and the left base would be the situation of the altered physical signs.

Should the abscess be localized in the subhepatic fossa, there would be tenderness and rigidity below the costal margin, extending downward and posteriorly toward the crest of the ilium.

If the lesser peritoneal cavity is the situation of the abscess the diagnosis becomes more difficult; an accumulation of pus here may present forward in one of several places, between the stomach and liver, the stomach and colon, the stomach and spleen, or below the colon. Altered physical signs at the left base are sometimes present.

Right-sided extraperitoneal subphrenic abscesses are caused most frequently by retrocolic appendicitis, infections of the liver, pancreas, or the kidneys.

The onset of the symptoms is associated with the systemic evidences of infection and are usually gradual. There are, of course, no symptoms of peritonitis, very little if any pain or tenderness, as these retroperitoneal spaces may be considered silent areas, just as infectious lesions of the brain or liver substance give rise to little or no pain; when, however, the abscess extends into the lumbar region, or advances along the falciform ligament anteriorly, tenderness is more easily elicited. In the latter the abscess may point in the middle line between the ensiform cartilage and the umbilicus, and be open in this situation without entering the peritoneal cavity. The signs at the right base are only marked in a well developed abscess, if the left lateral ligament is invaded; the left base may also show altered physical signs.

The left extraperitoneal subphrenic abscess, originates usually from the kidney, pancreas or spleen, and is apt to present in the lumbar region, but occasionally it dissects the peritoneum from the under surface of the diaphragm, under which circumstances there may be tenderness in the right hyphochondrium, with symptoms of compression of the left base.

Three of the following cases occurred at the Jefferson Hospital in the service of Doctor John H. Gibbon, to whom I am indebted for the privilege of operating upon them and of reporting them.

Case I.—A woman, sixty-three years of age, who had been ill for six weeks with what had started as gall-stone colic. She commenced to have fever soon after the onset of the illness and for the four or five days preceding the operation had rigors, with a temperature of 104° to 105°, followed by sweats. The patient was evidently very ill, and upon examination there was found a diffuse cellulitis extending over the lower part of the thorax, the right side of the abdomen as far as the umbilicus, and spreading from there to the right iliac crest and loin. A little to the right of the costoxyphoid angle there was a fluctuating area about two inches in diameter.

An anæsthetic was administered and an incision made over this fluctuating area which liberated a large quantity of pus. A sinus was found leading through the abdominal wall to a secondary abscess in the subhepatic fossa, containing between a pint and a half and two pints of pus. On account of the extensive cellulitis it was not deemed wise to open the general peritoneal cavity, and after placing a gauze pack covered with guttapercha tissue at the base of the gall-bladder, the operation was terminated. There were no gall-stones liberated with the pus and none discharged afterward. The patient made an uneventful recovery and is reported to be well at this time, some eighteen months after the operation.

There is some doubt in regard to the origin of this infection, but I am inclined to believe that subhepatic fossa became infected from a cholecystitis and from there the infection spread to the right anterior intraperitoneal fossa around the anterior margin of the liver.

Case II.—W. C. F., age thirty-three, male. The family and previous history had no bearing upon the present illness. On August 9, 1911, the patient was seized with very severe pain in the region of the gall-bladder, which radiated to the right shoulder. He was nauseated but did not vomit until after salts had been administered to him. He was admitted to the Medical Ward of the Jefferson Hospital, August 11. At that time he complained of a dull, aching pain over the gall-bladder, much less severe than at the onset; temperature 100 3/5°, pulse 106, and a leukocytosis of 18,400. I saw the patient August 15. At this time his temperature had fallen to 99° and the leukocyte-count was 10,600; the pain was described as much less tender upon physical examination. By deep palpation a moderate amount of tenderness was elicited in the region of the gall-bladder, still less over McBurney's point, and no appreciable rigidity of the recti muscles. I concurred in the diagnosis of cholecystitis, which was subsiding, and advised his transfer to the Surgical Ward.

On August 18, his leukocytes rose to 14,600, and the following day he was sent to the Surgical Ward. I saw him on the morning of the 20th. At this time a distinct mass could be felt reaching a little above the level of the umbilicus on the right side. I then felt that we had a high posterior appendix to deal with and operated the same day. Upon opening the abdomen the gall-bladder and ducts were normal, but the ascending colon was pushed forward by a mass behind it and was bound down by adhesions to the outer side. The general peritoneal cavity was packed off and the adhesions broken up, liberating a moderate amount of pus; a necrotic appendix was lying behind the colon and reaching high up toward the gall-bladder, this was removed and the abscess drained through the rectus wound, posterior drainage was not thought necessary.

Following the operation the patient ran a slightly elevated temperature, going as high as 101°, but became normal on the 10th day. From then on it gradually rose again and by the twenty-fourth day assumed the septic type, accompanied by chills. Frequent examination failed to find a reason to justify further operative interference. The patient had several chills on succeeding days, and continually lost weight, and, while there was no pain, he complained constantly of great weakness. The wound continued to discharge pus rather freely and on the forty-third day after the operation friction sounds were heard at the right base, two days later it was evident that a pleural effusion existed.

The patient died of exhaustion on the forty-seventh day following the operation.

Autopsy.—Pleura: On the right side shows a few adhesions at the apex; the cavity contained 60 c.c. of slightly blood-tinged fluid.

Peritoneum: To the right of the umbilicus the intestines were knotted together by numerous adhesions, which were separated with difficulty; these extended up to the under surface of the liver, and when broken up, this region shows numerous small pockets of pus, a large pocket behind the ascending colon communicates with a sinus in the abdominal wall, a branch of this sinus extends up the muscle in the abdominal wall for a distance of 10 centimeters. The liver extends two finger's breadth below the margin of the ribs in the midclavicular line; the liver is normal in size, somewhat soft in consistency. On the posterior surface of the right lobe there is a necrotic area 13 cm. in diameter and 1 cm. deep; it is covered by shaggy, grayish-yellow tissue, posterior to the gall-bladder and between the right and the left lobe the finger can be passed up into the liver tissue into a cavity 5 cm. in diameter, filled with necrotic material and pus.

Kidneys: The right kidney measures 13 x 5 x 4 cm. and resembles its fellow except that at the right upper pole, anteriorally, there is a necrotic area 5 cm. in diameter and 5 cm. deep. The cavity in the liver and that just described in the kidney constitute respectively the top and the bottom of a retroperitoneal abscess; while it probably communicated with the sinus mentioned above. This was not demonstrated owing to the fact that the abscess was not thought to exist and was only discovered on removing the kidney after all of the normal relations had been disturbed. The abscess had apparently started in the retroperitoneal tissues, gradually invading both the liver and kidney. Its situation marked so accurately the point of greatest tenderness that I am of the opinion that the infection occurred here early, but probably from the escape of pus through the sinus it failed to reach sufficient size to give the distinctive signs.

Case III.—A woman, seventy-one years old. She had been conscious of a pain in the right lower abdomen for the past month and for the last two weeks had been unable to extend her right thigh; five days before admission she discovered a large mass in the region of the cæcum; for the last three days she had had chills followed by sweats.

Upon admission to the Jefferson Hospital, Aug. 26, 1911, the temperature was 101 3/5°, pulse 120, respiration 20; physical examination showed a large tender mass in the right iliac region. Operation was performed, shortly after admission, through a Kammerer incision; a large appendiceal abscess was opened and a rather long retrocolic appendix was removed. The abscess cavity was then drained through the anterior wound.

The subsequent course of this patient very closely resembled the other appendix case, just described; the temperature gradually became septic in character and the patient lost weight and strength. Frequent physical examination failed to disclose any accumulations of pus or evidence of peritonitis; drainage from the original wound was still quite free.

The day following the autopsy on Case II, I determined to establish posterior drainage in this case and to explore the region in which the abscess had been found in the previous case. Using the triangle of Petit as my point of entrance I connected this with the original wound but failed to find that this liberated any accumulation of pus. I then passed a long curved pair of hæmostats up the outer border of the right kidney, to its upper pole, and in this region, or a little beyond, entered an abscess containing about five ounces of pus. The hæmostats were admitted their full length without meeting with any resistance; the lower end and posterior margin of the liver could be felt in the wound, so that the abscess must have been in, approximately, the same position as in Case II. The patient's temperature gradually fell, reaching and remaining normal on the tenth day; her recovery was uninterrupted although slow, probably due to her advanced age.

Case IV.—A lad, seven years of age, had complained of pain in the left hypochondrium for the last fifteen months; recently the parents noticed a protrusion of the ribs on that side. Upon admission, Aug. 20, 1912, the left side of the thorax was found to be distinctly bulging from the seventh to the eleventh rib in the anterior axillary line; the breath sounds over this area were normal but by deep palpation a mass could be felt, about in the position one would feel the spleen or a little above it. The radiogram showed a shadow in this position and also showed evidence of tuberculosis in the lungs, consisting of an increase in the amount and the density of the fibrous tissue.

Believing that I had an extraperitoneal subdiaphragmatic abscess to deal with, I determined to avoid, if possible, having the drain pass through either the pleura or the peritoneum.

The abdomen was explored through a left-rectus incision just below the costal margin revealing a mass above, and anterior to the spleen; this was walled off from the rest of the abdomen by gauze packs and a second incision made through the skin just below the ribs in the left flank; the peritoneum was exposed, then with a finger in the abdomen as a guide, the peritoneum was dissected from the diaphragm through the second incision until the abscess was broken into. The abdominal wound was then closed by an assistant who had remained clean for that purpose. The abscess was then explored and found to extend to the region of the cardia, and to penetrate the diaphragmatic muscle a little to the inner side of the left nipple line and well posterior, but did not communicate with the pleura or the peritoneum. Drainage was established by means of rubber tubes and the patient's convalescence was uneventful.

Treatment.—The treatment of subdiaphragmatic abscesses consists primarily, in establishing drainage. If a mass presents in front it should be reached through an abdominal incision without opening the general abdominal cavity if possible, or if this danger cannot be eliminated, the peritoneum should be opened below the abscess and the general cavity protected by gauze before evacuating the abscess. If the abscess is situated in the subhepatic fossa or is retroperitoneal on either side, it can be reached through a loin incision alone, or in conjunction with an abdominal incision through which the lower limits of the abscess can be determined and the dissection which is conducted through the loin incision aided and guided to the abscess without opening into the peritoneum. This accomplished the abdominal wound can be closed by an assistant who has remained clean for the purpose.

If there is reason to fear that the peritoneum may be entered in the effort to reach the abscess the intraperitoneal site may be walled off from the general cavity of the peritoneum by gauze packs introduced through the abdominal wound.

When the physical signs are well marked at either base the lung is apt to be displaced upward and the diaphragmatic and parietal layers of the pleura are frequently adherent, or in contact, so that they may readily be united. Under these circumstances the transpleural route is thought, by some, to be the best. This may be conducted in two stages, the first of which consists in resecting a rib, or ribs, and uniting the pleural surfaces and a day or two later exploring beyond these.

It is permissible to precede this operation by an exploring needle, provided the operation is to follow at once, keeping in mind the danger of infecting the pleural cavity; this danger may be lessened by leaving the needle in place until the pleura is incised and, if necessary, the two surfaces united by sutures.

This method has the very great disadvantage of endangering the pleura, both to the infection or to the formation of pyopneumothorax, and the difficulty in some cases of maintaining adequate drainage. On the other hand, there are very few subdiaphragmatic abscesses that cannot be dealt with satisfactorily by one or the other method, that is, by direct incision, as in my first case, or by a loin incision, and when necessary associated with an opening in the abdomen.

In reviewing the reported cases, it would seem that the intraperitoneal abscesses form pus much more rapidly than the extraperitoneal ones do, the physical signs are detected earlier, tenderness and rigidity are apt to be present and well marked, even if the abscess has not reached large proportions, the infection is less apt to pass beyond the original limits of the abscess and thorough drainage is more easily accomplished.

The retroperitoneal abscesses are more insidious in their onset, are detected with greater difficulty, the infection is liable to extend far beyond the walls and into region where it is impossible to follow.

In neither of the extraperitoneal cases, II and III, was it possible to make a positive diagnosis of abscess, and had I not witnessed the autopsy on the former of the cases I should have not sought the abscess in the latter. In those cases where abdominal infections are known to exist, which progressively grow worse, and especially those that have come to operation late, I believe that we are justified in exploring the retroperitoneal subdiaphragmatic area on what would otherwise be slight evidence, that is persistent localized tenderness, accompanied by altered physical signs at the corresponding base.

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EXPERIMENTAL ANATOMIC AND PHYSIOLOGIC OBSERVATIONS BEARING UPON THE TOTAL EXTIRPATION OF THE COLON.*

BY AUGUST SCHACHNER, M.D.,

OF LOUISVILLE, KY.

WHEN we consider the arrangement by which 20 or more feet of small intestine are being supported through a peritoneal attachment measuring five inches (vertebral border of mesentery); when we think of the inguinal region as the lowest and weakest portion of the abdominal wall, and the frequency with which hernias result from the gravitation of abdominal contents against this lowest and weakest point; when we examine the costal arrangement by which it becomes necessary in respiration to raise the costal cage against gravity; when we compare the darkened lungs of the human subject with the clean pink lungs of the quadruped living under the same conditions as a proof of how unequal the cilias are in their efforts to lift the dirt and bacteria laden mucus against gravity; and when we watch the pathetic efforts of the tubercular subject to raise against gravity his expectoration, we get the full swing of the disadvantages of the upright position.

These are but a few of the disadvantages as pointed out by Pohlman, and more fully set forth by Wiedersheim in his excellent work, "Der Bau des Menchen."

That man advanced in the evolution we freely concede, but we must not be unmindful of the price that was paid for the advancement, and that will continue to be paid until, through the natural process of evolution or some artificial means, a better adaptation to the condition can be arranged. The work of Mr. William Arbuthnot Lane, which has extended over a period of more than ten years, and his writings of the last few years have done more to arouse an interest in this subject than anything else excepting the work of Elias Metchnikoff, who through his investigations upon the bacterial flora of the intestine has aided independently and deserves to share with Mr. Lane the credit of this awakened interest. Mr. Lane's proposal and the procedure which he for ten years has followed, namely, the removal of the entire colon in properly selected cases, where the sewerage functions of the large intestine are inadequate and unsatisfactory, has in a measure staggered the medical world through its seemingly heroic nature. We are inclined to suspect that in many instances the consideration of the subject ended with this initial surprise and a prompt condemnation of the proposal. The question hinges upon the correctness of the premises and not upon our impression as to whether or not we believe the procedure to be heroic.

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* Read before the Southern Surgical and Gynæcological Association, December 18, 1912.

Just about 100 years ago the medical world ridiculed and doubted the performance of McDowell in the removal of an ovarian tumor. An operation considered in the light of that period was far more heroic than the removal of the colon considered in the light of the present developed state of intestinal surgery.

Direct observations of Mr. Lane's work at Guy's Hospital, almost two years ago, gave me the impression, which in time grew to a conviction, that Lane's procedure was here to be reckoned with, and it only remained for time and experience to define its limits and perfect its details.

Its reception will doubtless be a stormy one. It will always remain an operation that deserves to be carefully considered and painstakingly performed.

Mr. Lane has been accused of being too radical. This is not at all unreasonable. The natural place of a leader is in advance of his followers, and in this movement Mr. Lane undoubtedly occupies the position of leader.

The technical difficulties that attend the operation are several.

Shall the ileum be connected with or without the additional step of colectomy? Shall the attachment be made end-to-end, side-to-side, or end-to-side? To these belong the difficulties of properly selecting the cases suitable for the procedure and the operative details common to every intra-abdominal operation, as minimizing adhesions, avoidance of shock, and lastly, infection directly or indirectly through imperfect suturing.

A series of experiments upon dogs was conducted by the writer with the hope of possibly shedding a little light upon the debatable operative side of the question.

To avoid too much encroachment upon time and space we omit details of each experiment.

Only those methods were tried that seemed desirable, namely, side-to-side, end-to-end and end-to-side. The invagination was tried in the end-to-end because it seemed suitable in view of the smaller circumference of the small intestine as compared with the receiving lumen of the large intestine.

The end of the small intestine was placed parallel with the end of the large intestine and one-half of the circumference united by means of a through-and-through stitch with the corresponding half of the large bowel.

The traction sutures, the one at the mesenteric attachment and the other at the opposite point, were introduced from within, securing a good, strong purchase at these points and leaving the one end of each suture long and armed with a milliner's needle. The needles were pushed through the wall of the large intestine at a point about 2 inches beyond the line of suture, and used to aid in effecting the invagination. Following this the remaining half was closed by means of a Connell stitch. By pushing upon the small intestine from above, and pulling from below by means of the traction sutures, an invagination was effected, bringing broad peritoneal surfaces together.

The invagination was made permanent by the application of two continuous seromuscular sutures, one for each half of the intestinal circumference. The traction sutures were severed close to the intestinal wall, while traction was being made which resulted in the disappearance of the end within the lumen of the intestine. The minute punctures were touched with 95 per cent. carbolic acid, followed by alcohol, and buried by one or two Lembert sutures.

Lateral anastomoses were made in two ways: in the one the blind end was left needlessly long beyond the opening in the proximal limb; and in the other this was reversed, *i.e.*, made as short or without any blind end propecting beyond the anastomotic opening in the proximal limb. Otherwise the lateral anastomoses were made in the usual way.

In the end-to-side, two methods were tried. In the one, the proximal end was invaginated into the side of the distal limb through two mattress sutures after the method of Jesset, and the invagination made permanent and secure through a continuous Lembert suture applied separately to each half of the circumference of the invagination.

FIG. 1.

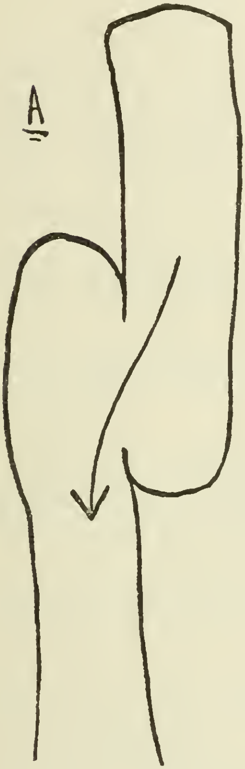


FIG. 2.

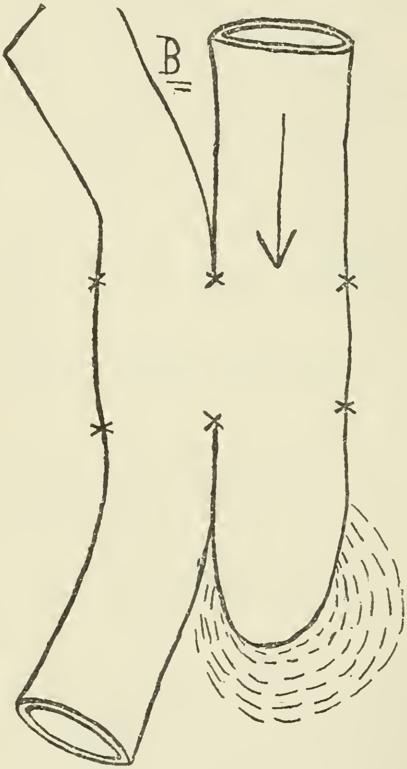


Fig. 1.—Showing tendency for the two sections to pull into a straight line in a lateral anastomosis when there is no excessive overlapping.

Fig. 2.—Showing tendency of the blind end of the proximal limb to become distended beyond the opening where an excess of overlapping exists.

NOTE. X, X, X, X, the dead areas of the intestine due to the division of the circular fibres.

The other end-to-side connection was performed according to the usual method of connecting the duodenum to the stomach or a lateral anastomosis, namely, an outside row of seromuscular sutures and an inside row of through-and-through sutures.

The experiment to which I wish to direct especial attention is the following: In a moderate sized brindle bull dog the mid-point of the descending colon was divided. Its distal end was closed by invagination, and its proximal end brought through and sutured to the peritoneum in the mid-line. The end beyond this peritoneal line of suture was passed between the separated fibres of the left rectus in its middle and made to emerge on the surface at a point about one inch external to the outer border of the rectus. An ileorectostomy was made between the ileum, four inches beyond the valve, and the large bowel as near the anus as conditions would permit. The ileorectostomy opening was about two inches, which for the size of the animal was unusual.

It will be seen that an effort was made to favor the passage of the intestinal contents through the anastomosis and in the natural way through the short rectum by making the opening large and the distance between the anastomosis and the anus short, the line of least resistance.

On the other hand, an effort was made to retard the passage through the other course by compelling it to pass the ileocæcal valve, traverse the greater distance, and overcome such resistance as the above described arrangement at the artificial anus would offer. The result was that practically all the movements passed through the ileocæcal valve, traversing the longer distance, overcoming the obstacles in the abdominal wall; and were discharged through the artificial anus instead of the natural one—the gastro-enterostomy story over again.

The few movements that passed the natural anus were fluid or semifluid with minute evidences of blood for at least 11 weeks after the operation.

Those that passed the artificial anus were formed and had the appearance and consistency common to the normal movement of a dog. The nutrition of the dog for six weeks was impaired. This was attributed more to the habits of the dog to lick his wounds. We were not entirely successful in preventing this.

The local disturbance and impaired function at the site of the anastomosis played the principal part in the interference with his nutrition. His nutrition finally returned to normal.

Such movements, few in number, and at times only that passed by the natural anus, were indicative of a proctitis at least up to 11 weeks following the procedure. The other dogs did not show any indication of an interference with the nutrition. If there was any undue thirst, we failed to observe it. The movements were all semisolid at the beginning but without any indication of proctitis or other inflammatory disturbance such as occurred in the dog with the artificial anus. In the course of about two weeks, the movements became formed. Up to three months after the anastomoses they remained formed but were never in that desiccated state common to the movements of this animal.

The end-to-end union gives the most perfect functional results (Cannon and others).

The chances for infection when carried out by any of the end-to-end methods are considered greater than those that attend the lateral anastomoses or an end-to-side as usually performed.

The end-to-end may in time be so perfected that its risks from infection will be no greater than those that attend the lateral effort. In the *Transactions of the Thirty-seventh German Surgical Congress,* Moschowitz describes a set of instruments for controlling or at least minimizing the risks of infection from the intestinal contents.

While the simple needle and thread should do the work, further improvements in the prevention of the escape of intestinal contents or the exposure of the intestinal mucosa are desirable.

With a given number of operators of varying experience, the immediate results of a lateral anastomosis would likely be in favor of the lateral method.

The particular advantages ascribed are that it is easier to secure the approximation of serous surfaces in this than in the end-to-end.

Furthermore, the difference in the sizes of the joining limbs present no obstacle. The chief disadvantages of the lateral method seem first that it is practically a triple operation.

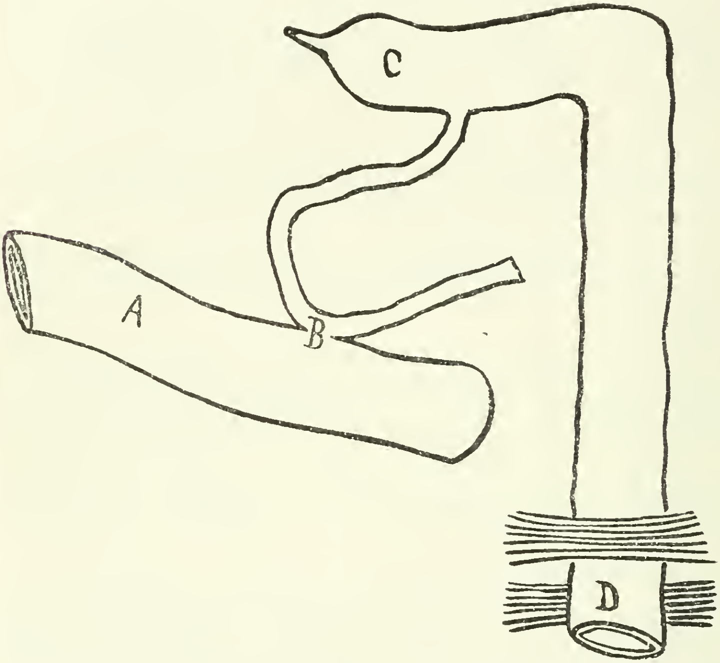
The secure invagination of the ends where two ends are to be dealt with, is not always quite so simple nor as rapid as we sometimes would like.

Second, if the opening is a large one, we have a large dead area as the result of dividing a corresponding section of circular fibres, and if the opening is a small one, the danger of the opening becoming in time insufficient, is not altogether imaginary. The liquid character of the contents of the ileum reduces this danger to a minimum. The blind end beyond the anastomosis if it exists will in time undergo dilatation and may become a source of disturbance. If the anastomosis is made snug, *i.e.*, without any projecting blind ends, a favorable change occurs in the every increasing tendency of the two limbs pulling themselves in a straight line which results in a condition not unlike the end-to-end anastomosis.

The end-to-end union performed in the usual manner, has practically all the advantages of both without the disadvantages of either.

The symptoms and signs of intestinal stasis as well as the pathologic anatomy, have been presented by several writers in the recent current literature.

FIG. 3.



Ileorectostomy with artificial anus. *A*, rectum; *B*, ileorectostomy; *C*, cæcum; *D*, artificial anus just beyond the separated fibres of the rectus muscle.

We forego repeating what is clearly set forth by Mr. Lane upon the pathology and the complete clinical report by Mr. Chapple of the end results of 50 cases. These two papers can especially be commended, as they represent the views as expressed by Mr. Lane and his associate. (*British Med. Jour.*, April 12, 1911.)

According to Gerster and others, the bands and membranes are due to a colitis and pericolitis, the result, as Pilcher expresses it, of a long-continued, or oft-repeated mild infection of the peritoneal covering. It is, we believe, beginning to be realized that while the bands do support they also more or less interfere. It seems fair to assume that the arrest for an undue time of the bacterial-laden contents of the large bowel, especially where there is an abundance of moisture organisms and lymphatics, as in the cæcal region, that the continuance of such a condition for a long period will result in permanent changes.

The work of Metchnikoff plainly suggests the chemical side of the question, *i.e.*, the chemistry of the large intestine when its functions are for any length of time interfered with. Efforts are being made to solve the ill effects of the prolonged retention along these lines.

Systems of gymnastics are being worked out with the view of favorably influencing this condition, supplemented with bandages which add to the comfort and aid in maintaining a support of the blood pressure. The influence of an abnormally movable kidney as a factor in the development of splanchnoptosis has not received the attention it deserves. Few of us, perhaps, realize that the retroperitoneal position of the kidney when making excursions enables it to dissect loose through attrition the peritoneal attachment that served to anchor the viscera to the vertical column.

Gerster, whose opinions are deservedly worthy of careful consideration, expresses himself as follows:

" Prevention has a wide field of usefulness, especially here in America, where chronic colitis is almost endemic. A reasonable restriction of animal food will control putrefactive processes; a generous and daily use of fresh vegetable matter in the shape of well cooked and attractively seasoned dishes, will supply bulk and friction needed to induce normal and adequate peristalsis. The practice of what may be called ' physiological intestinal discipline ' should be inculcated from infancy and should become as much a part of personal hygiene as are ablutions and baths."

In closing, I wish to emphasize that the problem is comprehensive enough to accept all the assistance it can through gymnastics, bandages, regulation of diet and habits and still furnish an abundant per cent. of human wreckage, as Mr. Lane expresses it, for the surgeon to attempt to reclaim.

I wish to convey my thanks to Dr. Benjamin J. Lammers and Mr. Morris Flexner for valuable assistance rendered me in this work.

Note.—Since the meeting of the Southern Surgical and Gynæcological Association, held December, 1912, I have received a communication from Mr. Lane defining his position upon the question of intestinal stasis and cholectomy. In view of the growing interest in this question, I deem it fair and proper to append with his permission, his views, as follows:

" I do not think my treatment has changed. I believe that if the patient is at all wasted, and the colon is distinctly static, it is far better to remove the large bowel. In other words, when the removal of the large bowel exposes the patient to but little added risk, I prefer to remove it. The result of removal is far better than that of short circuiting. At the same time, I do a great number of operations of short circuiting, namely, putting the ileum into the pelvic colon immediately below the last kink for tubercule, rheumatoid arthritis, Still's disease, neuraglia, changes in the thyroid associated with stasis, as exopthalmic goitre, diverticulitis, etc., for which cholectomy is not called for. If in these cases I get trouble subsequently in the cæcum, which is rare, I remove the large bowel. I do a large number of short circuitings, as the conditions benefited by it in an extraordinary manner are *very numerous*. Those calling for removal of the large bowel are comparatively rare. I have not lost a patient in my female ward at Guy's Hospital from short circuiting or from removal of the large bowel for, I think, three years. Men are more difficult and perhaps more dangerous."

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DIVERTICULITIS OF THE SIGMOID.

BY JOHN DOUGLAS, M.D.,

OF NEW YORK.

Clinical Professor of Surgery in the New York University and Bellevue Medical College;
Visiting Surgeon, Bellevue Hospital; Senior Assistance Surgeon, St. Luke's Hospital.

The development of the recognition of diverticulitis of the intestine as a definite clinical disease with its own pathology and symptomatology is of considerable interest. The existence of diverticula of the intestine has been known for over a hundred years, but less than ten years ago in *Nothnagel's Encyclopedia* (edition 1904) in writing of acquired diverticula of the intestine the statement is made "as these lesions are chiefly of anatomic interest and have very little clinical significance, only a few general remarks will be made on this question."

Sixty years ago Virchow[1] described areas of localized peritonitis occurring on the colon and causing adhesions. This inflammatory process he considered to be due to constipation. For many years little attention was paid to these observations. In 1889, Windscheid[2] reported three cases of acute inflammation of the ascending colon. Graser[3] ten years later was the first to prove the relationship between diverticula of the colon and these inflammatory processes of the intestinal wall.

In 1904 Beer,[4] in an admirable article and review of the then meagre literature almost entirely in the German medical journals, called attention to the relation between the various pathological reports and clinical findings. In 1907 Brewer[5] reported on six cases of left-sided abdominal suppuration, in two of which the direct relation between diverticula and the inflammation were demonstrable, in the other cases problematical. In the same year Mayo[6] reported five cases and collected eighteen cases from the literature, and in 1908 Telling[7] analyzed reports of one hundred and five cases.

Since then there have been numerous reports of cases in the literature, several articles coming from the St. Mary's Clinic in Rochester, the most recent of which by McGrath [8] reports on twenty-seven cases.

The reports of these cases of diverticulitis of the intestine are frequently from autopsy records, or from operative findings when the operation has been performed for some other condition, or after an incorrect diagnosis. Charles Mayo [9] reports making a probable diagnosis in seven of the twenty-seven cases reported. In some cases where resection of the sigmoid has been done for carcinoma, a preëxisting diverticulitis has been found, probably as an etiological factor. Also, it has not been very rare in the past to see in the large general hospitals cases of apparently inoperable carcinoma of the sigmoid where perforation with resulting abscess has occurred; and after drainage, with or without development of a fecal fistula, the symptoms of carcinoma have disappeared.

Because of these facts, the history of the following case is reported as a typical case of acute diverticulitis, the history, symptoms, and physical signs being sufficiently pathognomonic to enable a diagnosis to be made before operation:

C. G., male, aged forty, referred to the writer January 8, 1912, by Dr. J. F. Bell.

His family and previous personal history have no bearing on the present condition beyond the fact that he had always been troubled with flatulence.

The first symptoms of the present illness appeared two years ago, when, after exposure to cold and wet while duck shooting, he was attacked by severe colicky pains in the abdomen, most severe in the left iliac region. Six months before the present attack, while on a train, had a similar seizure. He was ill for ten days, his temperature during this time ranging between 100° and 101° F.

Three days before the operation he had another attack of colicky pain, most severe in the left iliac region. His bowels moved with catharsis, but movements of the bowels or the passage of gas caused pain in the region of the sigmoid. There was also present an irritability of the bladder, and micturition caused pain in the lower abdomen. On January 7, the temperature was 100° F., pulse 108, leucocytes 13700, with 76 per cent. of polynuclear cells. The following day temperature was 103° F., pulse 120, leucocytes 21000, with 88 per cent. polynuclear cells. A high enema was given after he entered the hospital, without result.

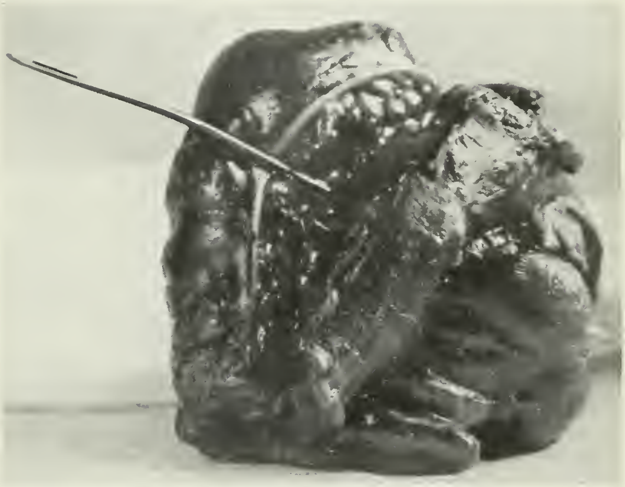
Physical Examination.—The patient was a well-developed, muscular man, 6 feet 3 inches tall. Abdominal examination showed nothing but moderate rigidity, tenderness, and an indefinite resistance suggesting a mass in the left iliac region. With the finger in the rectum, however, this mass could be definitely made out bimanually, just above the prostate and to the left side, apparently adherent to the posterior bladder wall.

A radiograph was taken after a high enema of bismuth had been given. This showed a narrowing of the sigmoid flexure, but there was no complete obstruction anywhere in the colon.

From this data a probable diagnosis of diverticulitis of the sigmoid was made, and an immediate operation advised.

Operation confirmed the diagnosis. There was a marked thickening of the whole sigmoid flexure which, with the mesosigmoid, was adherent to the posterior bladder wall, thus accounting for the pain in the lower abdomen on micturition. In the mesosigmoid there was a thrombosis of the vessels, and an abscess had developed in the thickened mesosigmoid. Because of the thrombosis and damage to the mesosigmoid, a resection of the sigmoid and removal of the inflamed mesosigmoid was done, and an end-to-end anastomosis by suture was performed. A large rubber dam drain was inserted between the point of anastomosis and the posterior bladder wall. The reason for doing the end-to-end anastomosis, rather than performing the resection by the Mikulicz three-stage method, or the Bloodgood method of anastomosis, was due to the facts that the area resected was so low in the sigmoid, and the distal segment which had been adherent to the bladder wall so œdematous and swollen that the distal segment could not have been brought out of the wound, and these two methods of treatment were impossible. Also, immediate anastomosis was not contra-indicated, as there was no acute obstruction present, but perhaps an anastomosis by the

FIG. I.



Diverticulitis of sigmoid. Intestine has been split open opposite mesenteric border. Probe passes through opening of diverticulum into abscess in greatly thickened mesosigmoid.

method of invagination of the upper into the lower segment, might have lessened the chance of a fecal fistula.

Five days after operation a fecal fistula developed, which slowly closed, leaving a small sinus which occasionally discharged gas, but this closed in July, and the patient now, more than a year after his operation, has no trouble except a slight weakness in the wound, where a small ventral hernia is developing. The bowels move naturally, without catharsis, once or twice a day.

Examination of the specimen removed showed a small opening in the mucous membrane of the intestine, through which a probe could be passed into the thickened mesentery, as is shown by the illustration. Microscopical examination proved that the margin of this opening was lined with epithelium, and the report from the pathologist was "diverticulitis of the sigmoid." (See Fig. 1.)

Articles on this subject within the past few years by Wilson and MacCarty,[10] Giffin and Wilson,[11] Wilson,[12] MacCarty,[13] Wilson,[14] Mayo,[9] McGrath[8] (all from the St. Mary's Hospital in Rochester); Rowlands,[15] Taylor and Larkin,[16] Cameron and Rippman,[17] Hartwell and Cecil,[18] Bruce,[19] Telling,[20] Barbat,[21] Abbott,[22] Erdmann,[23] and Powers[24] make more than a brief review of the etiology, symptoms, and treatment superfluous.

Etiology.—Diverticulitis is said by Telling[20] to be twice as frequent in men as in women. While the condition has been observed in children (Ashhurst,[24] Hartwell and Cecil[18]), it is more frequent in the later decades of life. As to the direct causation, while many theories have been advanced little has been proved. An inherent or congenital weakness in the musculature of the intestinal wall seems to be the most probable predisposing factor, this weakness existing in relation to the points of exit of the veins in the intestinal wall. Obstruction to the return flow of blood in the mesenteric veins has been supposed in some cases to be a cause of this weakness. Traction on the mesentery has been suggested as a cause of weakness in the small intestine, as diverticula of the small intestine nearly all occur in the mesenteric border, while in the colon they are frequently found in the lateral wall or opposite the mesentery in relation to the appendices epiploica.

Age, obesity, constipation, flatulence, general muscular debility, loss of weight, all may be factors in increasing the congenital or acquired weakness and lessening the resistance of the intestinal wall, or increasing the pressure within the intestine and thus causing the intestinal wall to protrude at its weakest point forming the diverticulum. Telling[20] calls attention to the importance of a history of straining at stool as a cause of perforation.

It is difficult to understand, however, why, if constipation is a very important etiological factor, diverticulitis should be more common in men than in women. Also, the patient in the case reported above was a well-developed, muscular man, presenting none of the etiological factors mentioned except flatulence.

Pathology.—Diverticula may be found anywhere in the intestine from the duodenum to the rectum. They are most frequent in the descending colon and sigmoid. While they occur in the rectum, they are rare in this portion of the bowel, due, probably, to its thicker muscular coat (Schreiber[26]). They may be single or multiple, as many as four hundred having been found in a single individual at autopsy. Careful search shows that they are comparatively frequent as, according to Mayo,[9] they may be found by careful search in one-third of the autopsies of middle-aged or older persons.

In the beginning they are small in size and are probably nearly all of the true type; that is, including all of the coats of the intestine. As they increase in size from pressure from within, the muscular coat becomes thinned out and becomes deficient, the circular layer giving way first, and there is often an atrophy of the mucosa with a hypertrophy of the submucosa. While they usually do not attain a large size, they may develop to the size of an egg.

Fæces may be forced into the diverticulum resulting in the formation of a concretion. When this happens ulceration of the mucous layer may occur, or even without ulceration of the mucous layer or concretion formation, there occur inflammatory changes in the wall and surrounding tissues, resulting in a peridiverticulitis. This condition may continue to exist as a subacute or chronic condition, with a resulting thickening and inflammation of the intestinal wall, or perforation may occur with the development of a localized abscess, a general peritonitis or the formation of a fistula. Perforation into the bladder has occurred. Cripps[27] states that the majority of cases of fistula between the bladder and large intestine are inflammatory and not malignant. It has also been shown that carcinoma is apt to develop at the site of the diverticulum. Mayo found that carcinoma had developed in seven out of twenty-seven cases of diverticulitis of the large intestine.

Symptoms.—Diverticula of the intestine, in the absence of inflammatory changes in the walls of the diverticula or surrounding tissues, probably cause little or no symptoms. In the presence of inflammatory changes, the symptoms will vary with the pathological conditions present. Telling,[20] in his analysis of the histories of forty-seven cases, found the average age at which symptoms appeared was fifty-five years.

As it is in the large intestine, particularly the sigmoid, that diverticula are most frequent, and that in this portion of the intestine conditions are most favorable to the formation of fecal concretions, it is in the lower left quadrant of the abdomen that symptoms of diverticulitis usually manifest themselves. As Hartwell and Cecil have pointed out, these symptoms often resemble those of an appendicits in the left side, varying with the pathological process in or about the diverticulum, similar to an analogous inflammation in the appendix. Thus we may have:

1. A mild subacute or chronic inflammation, undergoing remissions, causing pain and tenderness in the left lower quadrant at times, sometimes associated with bladder symp-

toms, especially increase of pain on emptying the bladder when adhesions exist between this viscus and the sigmoid. These symptoms may subside or the pathological process may result in:

2. A chronic inflammation causing thickening in the intestinal wall or mesentery, which may form a palpable mass and be mistaken for a carcinoma, or adhesions to other loops of intestine resulting in signs of intestinal obstruction due to these adhesions, or to narrowing of the calibre of the intestine involved.

3. Acute inflammation, or perforation due to ulceration of the wall of the diverticulum, resulting in a general peritonitis or localized abscess with symptoms on the left side, similar to those caused by an acute inflammation of the appendix.

4. Perforation of a localized abscess into the bladder, or externally on the left side with the formation of a fecal fistula.

5. Development of carcinoma at the site of the diverticulitis.

In addition to the symptoms caused by the above-mentioned conditions, cases have been reported of perforation into a hernial sac, the formation of a loose body or fecal concretion free in the abdominal cavity, and the development of a metastatic abscess in the liver.

Differential diagnosis must be made from carcinoma, tuberculous peritonitis, constriction of the intestine due to other causes, and in the presence of perforation, from other causes of peritonitis. In the presence of a palpable mass, the absence of symptoms of ulceration and melena will aid in the differential diagnosis from carcinoma.

Treatment.—Probably no diagnosis of diverticulitis will be made until an inflammatory process begins in or about the diverticulum. In the presence of perforation the treatment is essentially surgical. If the diverticulum is single and the inflammatory area is localized, a local excision with closure of the opening left by the excision may be practised. If there is considerable inflammatory thickening of the intestine, or a thrombosis of the mesentery, or an abscess in the mesenteric wall resulting in impaired circulation of the intestine, a resection should be performed. If a localized abscess is present, it is probably better to drain this, with subsequent repair of the fecal fistula, if such develops.

In case it is necessary to do a resection, in the presence of obstruction, where possible the three-stage operation of Mikulicz should be done, or the anastomosis after the method of Bloodgood. When no obstruction is present, and the area resected is high in the sigmoid, a lateral anastomosis should be most satisfactory; while if low down, the anastomosis by invagination of the upper into the lower segment should be the best method.

Although one of the less common abdominal pathological lesions, in making a diagnosis of an abnormal condition in the left lower quadrant of the abdomen, the possibility of the presence of a diverticulitis must be considered. Also, in searching for the cause of a local abdominal abscess or general peritonitis of obscure origin, particularly if no lesion of the appendix is present and the pus has the characteristic odor of the colon bacillus, a perforated diverticulum should be thought of as a possible etiological factor. It is also to be remembered that rough handling of the colon in the course of an abdominal operation for some condition other than diverticulitis, has resulted in the perforation of a diverticulum causing a general peritonitis with fatal result.

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THE HERNIAL SAC IN ITS RELATION TO CONCEALED INTESTINAL INJURIES.

BY CHARLES M. REMSEN, M.D.,

OF ATLANTA, GA.

Concealed or subcutaneous injuries of the intestine, exhibiting lesions of more or less severity yet unassociated with a visible destruction of the intervening structures, while not frequent, nevertheless are far from unknown. Barring the minority of such accidents, based upon the dislodgement of and injury to the mesentery and its blood-vessels, leading to secondary dissolution of the intestinal wall, the greater portion of such cases is due to the sudden application of excessive pressure to the muscular walls of the abdomen, which in turn transmit this force to the underlying structures and thence to the opposite wall.

However, we are occasionally confronted with the picture of concealed intestinal injuries, where pressure, in lieu of being applied to the abdominal walls, has been exerted upon the tissues overlying an inguinal hernia.

There are factors, both as regards the relation of intestine to abdominal walls and to hernial sac and as regards the intestinal condition *per se,* which have a definite bearing, not only on the final outcome of the applied pressure, but also upon the methods by which this force may be applied.

Weakening of the intestinal walls, not only by disease but also by circulatory interference due to mesenteric trauma, is especially important in determining rupture, while intestinal distention, with which we are more frequently confronted, is a factor no less important. Probably the abnormal intestinal conditions are of greater frequency in injuries of herniated bowel, owing to the greater possibilities for interference with the vessels supplying intestine so located.

To a certain extent similar in their relation to the enveloped intestine, yet the abdomen and sac display anatomical and physical peculiarities quite different from one another, in so far as the reception and defence of pressure is concerned. The former is in part protected by a skeletal wall and in part by muscles fully capable of protecting the underlying intestine from ordinary pressure. The sac, which may be considered as a pyriform prolongation of the peritoneal cavity, consists of a neck or upper portion and a body. The former, generally speaking, is hemmed in by integument and a sparse muscular and aponeurotic covering and the pubic ramus. The body is enveloped on all sides by the elastic scrotal wall, and hence but poorly protected.

The methods by which pressure is applied varies. Crushing accidents, blows, horse kicks, falls, are responsible for the majority of concealed intra-abdominal intestinal injuries, while to these may be added, in the case of intrasaccal injuries, manual trauma, a product of the pernicious habit of the forcible reduction of herniæ.

The direct cause of such injuries has been a fruitful source of discussion, and generally speaking one must bear in mind the difference in the resisting power of the various walls—of the skeletal and muscular walls of the abdomen—of the muscular and integumental coverings of the sac, and of the skeletal bridge which underlies it.

Depending upon its direction and application, abdominal pressure may either be broken on the skeleton, may force muscular wall to rigid skeleton, or may approximate muscular wall to muscular wall. In the former case it is extremely unlikely that, without external evidences of injury or fracture, harm could be done the intestines or mesentery to any great degree. What changes occur when muscular wall is forced against the vertebral column, or the sacral promontory, or other points of the bony framework? The abdominal cavity is directly encroached upon and the intra-abdominal pressure greatly increased, due to the marked diminution of the size of its cavity; while the intestines, in great part, are driven from the immediate region of the greatest extra-abdominal pressure into areas free from this force, where they are temporarily fixed. The extra-intestinal pressure is focussed upon those sections " caught " between the opposing walls. The intra-intestinal pressure is greatly increased, not only in those imprisoned sections but also in the sections immediately adjoining these, as the gas and fluid are rapidly displaced from the former into the latter.

The action of the diaphragm in relieving intra-abdominal pressure as it is driven upward is neutralized, to all intents and purposes, by the reflex contraction of the other muscular boundaries of the abdomen. While the increased abdominal pressure is hardly in itself responsible for direct intestinal injury yet, by fixing the intestines, it is probable that the latter are more susceptible to synchronous blows with different points of application, and also to the injuries sometimes ascribed to muscular action alone, and to the possibility of the extrusion of a part of the tense wall, distended with gas and fluid, through the neck of a hernial sac.

The local increase in extra-intestinal pressure focussed upon bowel imprisoned between opposing walls is no doubt the greatest single factor in concealed intestinal injuries. The bowel wall, delicate as compared with the parietes, is ground, bruised, torn, and crushed against the bony skeleton, while the abdominal wall shows little or no evidences of the pressure.

Finally, the increased intra-intestinal pressure, due to the expressing of gas and fluid rapidly from one section of bowel to another, is occasionally the cause of an " explosive " rupture, when the increase in intra-intestinal pressure overcomes the resistance of the intestinal wall.

When muscular wall is forced against muscular wall there is no doubt but that the intra-abdominal conditions are altered very much, but there is great doubt whether only a rare case will show rupture or injured intestines under these conditions, so greatly is the shock ameliorated by the elasticity of the opposing muscular wall which acts as a buffer to the blow.

Similar principles may be applied under different conditions to the hernia sac and its contents. In its upper part, with its rigid background of pubic ramus and its thin unprotecting covering, conditions are ideal for a crushing injury, such as truss injuries, kicks, blows, etc. Unlike this the lower portion has no bony border, but is completely enveloped in thin elastic scrotal wall and yields readily to pressure; and the lack of support affords heightened susceptibility to explosive and crushing ruptures, to direct injuries, and to manipulative trauma, the latter so frequently associated in this location with bowel whose resistance has been lowered by constriction.

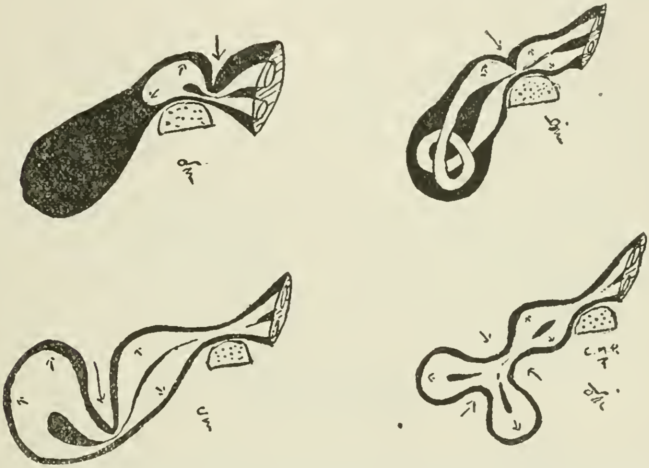
The fixation of the scrotum, the distention and amount of bowel in the sac, its condition and fixation, and the elasticity of the scrotum—all are important determining factors in such injuries and involve definite physical principles which make it possible to explain the outcome of the pressure.

The following cases which have been operated on by the writer for this condition are interesting in that they represent nearly all the different forms of concealed intestinal injuries with which one meets in the hernial sac.

Case I.—S. M. W., aged 27. Right inguinal hernia " caught down " 24 hours before admission. *Forcible reduction applied.* Condition persistently became worse. Is restless, toxic, shocked. Pulse 120, temperature 99.2°, white blood-cells 35,000. Abdomen: Marked distention. C. M. obliterated. R. M. everywhere limited. No visible peristalsis. No masses seen. Distinct bulging in flanks. Slight general tenderness of entire abdomen, but walls fairly soft. Tympany everywhere except in right flank, where there is slight movable dulness. Liver dulness 4 cm. above C. M. In right inguinal region there is a bulging which reaches from internal ring into scrotum, forming an oval swelling about 6 × 4 cm. Percussion note flat. Fairly soft. Skin movable over swelling. Slightly tender. Rectal examination: Marked bulging in anterior wall. Testes and epididymes normal.

Operation (Dr. Remsen): Under cocaine, skin and external oblique aponeurosis divided; the ilioinguinal and iliohypogastric nerves blocked and divided and a congenital sac filled with bloody fluid and strangulated omentum found. Digital examination revealed, higher up, what appeared to be a hernia reduced *en masse*. Abdominal exploration revealed the following: omentum and small intestine running through internal ring and into hernial sac, the " ring " having been displaced inward so that the swollen omentum had completely hidden the bowel in the sac. Divulsion of the ring and excision of the omentum allowed reduction of the bowel into the protected general cavity. The wall everywhere was in good condition even where compressed by the ring except for two ruptures, one completely through the circumference of the wall (Fig. 2, *c*) the other partially through (Fig. 2, *d*). General condition called for a quick enterostomy and tubes were inserted into both openings. A partial operation for hernia was performed quickly. Patient never rallied. Death in 24 hours.

FIG. 1.

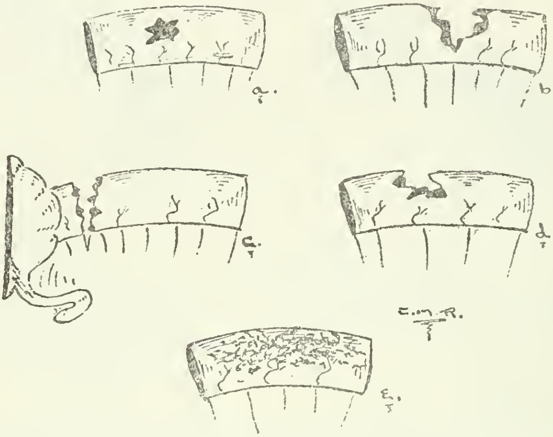


Hernial sacs seen in cross section representing, schematically, intestinal compression and dilatation due to pressure applied above the ramus (Case IV); over the ramus (Case V); to the scrotum (Case II); and manipulative pressure applied to the scrotum (Cases I and III).

CASE II.—J. L., aged forty-seven. Seven hours previous, while running for a street car, patient *tripped and fell, striking a rather large inguinal hernia upon a cobble stone.* Intense abdominal pain, nausea, and vomiting followed. Patient restless at examination. Pulse strong, slow, regular. Abdomen scaphoid; entire absence of respiratory movements; C. M. well marked; no distention. No masses nor visible peristalsis. General tenderness not localized. An extreme degree of abdominal rigidity existed. Submural palpation impossible. There is a small swelling in the inguinal region, tympanitic, very soft, compressible and tender and increased in size on coughing.

Operation (Dr. Remsen): Inguinal swelling explored first. A hernial sac filled with fecal matter and containing no bowel was exposed. Fecal material was seen escaping from abdominal cavity through inguinal canal into sac. Immediate abdominal exploration revealed a ruptured ileum (Fig. 2, *a*) and a peritoneal cavity soiled with intestinal contents. Suture of rupture and careful toilet of the peritoneal cavity and slight drainage completed the abdominal operation. Sac treated by drainage owing to soiling with the intestinal contents. Recovery with only slight recurrence of hernia.

Fig. 2.



Concealed intestinal injuries occurring in the hernial sacs (viz. text).

Case III.—M. B., aged twenty-two. Hernia two years. "Caught down" 48 hours before admission, with nausea and vomiting. *Forced manipulative reduction* 36 hours ago with disappearance of the mass and cessation of vomiting but with increase in pain which now extended to abdomen. Pulse slow and soft. White blood-cells 22,000. Pupils small. (Patient has been given large amounts of morphia.) Face anxious. Patient thirsty. Abdomen markedly distended. Moderately tender over lower portion. Respiratory movements diminished. No elevation of liver dulness. No shifting dulness. Large patent external (right) abdominal ring. No bowel in sac. Bowels moved once since onset. Owing to the masking of symptoms by morphia it seemed advisable to explore immediately.

Operation: Abdominal section revealed a section of bowel about 50 cm. in length limited by two indented circumferential impressions due to the pressure of the ring. In one portion of this section of bowel there was a definite bruising and reddening not at all resembling the bowel seen in a strangulated hernia (Fig. 2, *e*). This was viable, and active peristalsis occurred after artificial stimulus. The abdomen was closed and radical cure of the hernia followed. Recovery.

Case IV.—I. M., aged forty-nine. Fall from scaffold four hours previous, *striking his abdomen* (*left inguinal region*) *across projecting board.* At present lies on back moaning with pain, thighs flexed, cautious respiratory movements. Markedly shocked. Very large left inguinal hernia exists. Palpation reveals intense abdominal rigidity. Submural palpation impossible. Abdominal tenderness general. Hernial sac very tender, and even gentle manipulative measures cause great pain. Liver dulness at six R. No shifting dulness. Increased abdominal tenderness in L. I. F. Slight general distention of abdomen. Marked shock. Blood-pressure 65.

Operation: Left rectus incision. On opening peritoneal cavity there was an escape of gas and bloody fluid. Search revealed a ruptured ileum (Fig. 2, *b*) in close proximity to the internal ring (left) and some intestinal contents extruding from sac into abdominal cavity through the ring. Very small amount of intestinal contents seen in the abdominal cavity itself. From these findings it seemed that the rupture had occurred in the sac itself rather than in bowel that was in the abdominal cavity at the time of the accident. Resection and lateral anastomosis. Patient never rallied. Death in two hours.

Case V.—C. M., aged twenty-seven. Left inguinal hernia "caught down" several years ago and reduced successfully. Has been wearing truss for some time. Thirty-six hours ago *patient fell and compressed truss against pubic ramus, the hernia having been extruded during the fall.* Following this patient had severe abdominal pain, which, however, has diminished in the last 12 hours. Nausea but no vomiting. Abdomen now shows slightly diminished respiratory movements on left side. General condition normal. There is slight tenderness in left iliac fossa, well localized and corresponding to the area of abdominal tenderness. Hernial sac negative. General condition excellent and the local signs so mild and showing improvement so markedly that operation was postponed. Local conditions improved and patient discharged in three days with no abnormal symptoms.

Suggestive, then, is the history of trauma applied to a hernial sac, followed by acute abdominal signs and symptoms; the tense rigidity of the abdominal walls, as emphasized by Moynihan, in concealed abdominal ruptures; and the soft, tender, fluctuant and bulging hernial sac, an evidence of the escape of intestinal contents into this latter cavity. When coupled with the shock and general symptoms and signs which one would expect with such an injury, there is formed a group almost positively indicating a concealed injury or rupture of bowel contained, at least at the time of the accident, in the sac which has suffered the trauma.

I wish to acknowledge my thanks to Dr. William S. Halsted for his kindness in allowing me to report the four cases of this series that occurred while I was in his service at the Johns Hopkins Hospital.

ON THE DEVELOPMENT OF MALIGNANT DISEASE OF THE CERVICAL STUMP AFTER SUPRAVAGINAL HYSTERECTOMY.

BY VEADER NEWTON LEONARD, M.D.,

OF BALTIMORE, MD.

From the Gynæcological Clinic of the Johns Hopkins Hospital.

A PATIENT who, eighteen years ago, had had a supravaginal hysterectomy for an advanced pelvic inflammatory disease, recently presented herself a second time for treatment at the clinic. Examination revealed a moderately advanced carcinoma of the cervical stump. On looking over the records of the clinic, one other similar case was found. At Dr. Kelly's suggestion, I have prepared a brief report of these two cases with a review of the literature on the subject.

M. Q., a negress, aged forty-three, entered the hospital for the first time in December, 1894, suffering with a severe pelvic inflammatory disease. At operation, the omentum and sigmoid were found densely adherent to a tubo-ovarian abscess on the left side. The adhesions were released and uterus removed by supravaginal amputation together with the adnexa on each side. The patient made a rapid and uneventful convalescence. About six weeks ago, some eighteen years after her operation, she returned complaining of profuse vaginal bleeding. This had begun one month previously with a sharp hemorrhage which lasted four days. Two weeks later, the bleeding reappeared and had continued up to the time of admission to the hospital. At operation, Dr. T. S. Cullen had the patient first placed in the lithotomy position, when the cervix was carefully examined. The posterior lip of the cervix was found to be the seat of a roughened, friable growth which bled very readily on manipulation and which apparently had not extended beyond the cervical stump. There being no doubt of its malignant nature, the abdomen was opened through a generous mid-line incision, and the cervix removed by Wertheim's method. Considerable difficulty was experienced during the operation on account of the dense adhesions about the cervical stump, the bladder and ureters. The cervix, together with the growth and a wide margin of normal vaginal wall, was successfully removed, however, without injury to the ureters. Aside from slight suppuration at the lower angle of the incision, the patient made an uninterrupted recovery. Microscopic examination of the growth showed it to be squamous-cell carcinoma.

The second case, E. L., age thirty-eight, was first admitted to the hospital in January, 1900, complaining of an abdominal tumor. Examination showed the lower abdomen to be distended asymmetrically by a large cystic mass more prominent on the left side. At operation, Dr. Kelly found a large ovarian cyst on the left side and a somewhat smaller one on the right, both densely adherent to the uterus, bladder, omentum and intestines. After much difficulty, the adhesions were finally released sufficiently to allow the removal of both cysts together with the tubes and uterus, the latter being amputated at about the level of the internal os. The raw areas were then closed over as far as possible. The patient made a satisfactory recovery and was discharged well some three weeks later. She remained in excellent health until November, 1903, when she began to have a foul vaginal discharge. She was again admitted to the hospital, in July, 1904, having had two severe hemorrhages from the vagina, each of which had followed a vaginal examination by her physician at home. On admission, a fungating growth was found which occupied the entire cervix and the vagina for a short distance about it, and the entire anterior vaginal wall down to a point below the internal urethral orifice. In spite of the extensive vaginal involvement the growth seemed quite freely movable. At operation, Dr. Sampson found the pelvis filled with adherent loops of intestine and omentum. With much difficulty, these were freed and the cervix found, when it could be seen where the growth had extended upward. The ureters on each side were then freed and the cervix dissected loose laterally. Incision was then made into the bladder, the outer wall of which, together with the growth, was excised down to the internal urethral orifice. The entire growth was apparently removed with a large margin. On the seventh day the patient became very restless and a condition of anuria set in. After infusions of saline, the patient improved and towards evening, the temperature, which had risen to 104°, fell to normal. Her condition then improved steadily until the twelfth day when there again appeared high fever, nausea, vomiting and anuria. On the following day, the condition had improved slightly but on the fourteenth day there was again complete renal suppression with pain in the region of the left kidney. Under nitrous oxide anæsthesia, Dr. Sampson exposed the left kidney and a number of small abscesses were found scattered over the cortex. These were incised with the Paquelin cautery after stripping back the capsule. On the fifteenth day, the patient's condition was unimproved and on the sixteenth day she died. Microscopic examination of the growth removed at operation showed it to be a squamous-cell carcinoma.

Chrobak[1] was probably the first to call attention to the possibility of the development of a malignant growth in the cervical stump after supravaginal hysterectomy. He reported three such cases, in two of which carcinoma was found and in the other, sarcoma. A number of similar cases have since appeared in the literature from time to time, Botzong,[2] in 1902, being able to collect quite a large list. So many cases have been reported since the appearance of Botzong's monograph that it seems worth while to review again the entire literature, particularly as the number of cases now at hand is large enough to justify conclusions as to their real clinical significance.

In the following table, there is reviewed a list of all the cases which have been more or less completely reported up to the present, while following it, is a list of the cases which have been occasionally mentioned in the literature, but never completely reported.

Author*	Supravaginal Hysterectomy for	Type of Malignancy in Cervical Stump	Subsequent Development	Remarks
Botzong [2].....	Myomata uteri.....	Carcinoma..	4 years.	
Chaput [3]......	*a* Pelvic inflammation	Carcinoma..	1 year 3 mos.	
	b Pelvic inflammation	Carcinoma..	1 year........	Possibly coexisting.
	c Pelvic inflammation	Carcinoma..	6 years.	
	d Pelvic inflammation	Carcinoma..	2 years 6 mos.	
Chrobak [1].....	*a* Myomata uteri....	Carcinoma..		
	b Myomata uteri....	Carcinoma..		
	c Myomata uteri....	Sarcoma....		
Currier [4]......	Myomata uteri....	Carcinoma..	8 mos........	Probably coexisting.
		Carcinoma..		
Fleischmann [5].	Myomata uteri....	Carcinoma..	7 years.	
Freund [6]......	Menorrhagia.......	Carcinoma..	1 year 6 mos..	Probably coexisting.
Hargrave [7]....	Myomata uteri....	Carcinoma..	6 mos........	Probably coexisting.
Jacobs [8]......	*a* Myomata uteri....	Carcinoma..	1 month......	Almost surely coexisting.
	b Myomata uteri....	Carcinoma..	1 month......	Almost surely coexisting.
Kaufmann [9]...	Myomata uteri....	Carcinoma..	4 years.......	Found at autopsy.
Ladinsky [10]...	Myomata uteri....	Carcinoma..	6 mos........	Probably coexisting.
Leonard......	*a* Pelvic inflammation	Carcinoma..	18 years.	
	b Bilateral ovarian cysts and pelvic inflammation....	Carcinoma..	3 years.	
Lewis [11].......	Myomata uteri....	Carcinoma..	6 mos........	Probably coexisting.
Lumpe [12]......	Pelvic inflammation	Carcinoma..	1 year 8 mos.	
Manton [13].....	Myomata uteri....	Sarcoma....	3 mos........	Probably coexisting.
Menge [14]......	Myomata uteri....	Sarcoma....	9 mos........	Sarcoma later found in original specimen.
Newman [15]....	Myomata uteri....	Carcinoma..	7 years.	
Noble [16]......	Myomata uteri....	Carcinoma..	8 mos........	Probably coexisting.
Norris [17]......	Myomata uteri....	Carcinoma..	2 years.	
Olshausen [8]...	*a* Myomata uteri....	Carcinoma..	7 years.	
	b ?	Carcinoma..	7 years.	
Quenu [19]......	Myomata uteri....	Carcinoma..	5 years.	
Richelot [20]....	Myomata uteri....	Carcinoma..	6 mos........	Probably coexisting.
	Myomata uteri....	Carcinoma..	?	
	Myomata uteri....	Carcinoma..	3 years.	
Savor [21].......	Myomata uteri....	Carcinoma..	4 years.	
Schenk [22].....	"Large uterine tumor"..........	Carcinoma..	5 mos........	Probably coexisting.
Turner [23].....	Myomata uteri....	Carcinoma..	8 mos........	Probably coexisting.
v. Ehrlach [24]...	Myomata uteri....	Carcinoma..	1 year........	Probably coexisting.
Wehmer	Myomata uteri....	Sarcoma....	8 mos........	Probably coexisting.

* Figures after authors refer to bibliography.

In addition to the cases listed in the preceding table, Richelot,[20] speaks of Hartman [26] and Murtry,[27] each having seen one case, LeDentu, two cases and Péan [29] "many more." Christopher Martin [30] is reported to have seen seven instances of malignant disease in the cervical stump after supravaginal hysterectomy, developing from a few months to several years after operation. Ladinski [10] states that he has seen three cases in the addition to the one noted in the table. Savor [21] speaks of a case seen by von Hacker [31] and Olshausen [18] refers to one noted by Pawlik.[32] Batigne,[33] Condamin,[34] Krusen and Hammond [35] have also reported cases but I have been unable to secure their references. In the table, there are thirty-six cases, while about twenty more have been casually mentioned in the literature, making a total of somewhat less than sixty cases reported up to the present time.

The fact that carcinoma has occasionally developed in the cervical stump after a supravaginal hysterectomy has often been used as an argument in favor of panhysterectomy whenever circumstances demand the removal of the uterus, and indeed a number of surgeons have abandoned the subtotal operation on this account alone. When one considers that of the many thousands of supravaginal hysterectomies performed this complication, serious as it is, has been reported in less than sixty cases, it would seem that the abandonment of the operation on this account, for panhysterectomy with its higher primary mortality and familiar disadvantages, is unjustified. Botzong [2] in 724 cases of supravaginal hysterectomy, collected from representative European clinics, reports a primary mortality of 2.61 per cent., while in 499 cases of panhysterectomy the mortality proved to be 6.6 per cent. The occasional case of carcinoma developing in the cervical stump after supravaginal hysterectomy, even if considered as a life lost and added to the mortality statistics of that operation, would not materially alter Botzong's figures; panhysterectomy would still have a primary mortality more than twice as great. In other words, those operators who have abandoned subtotal hysterectomy for panhysterectomy through fear of subsequent malignant degeneration in the cervical stump are probably sacrificing several lives to save one. Furthermore, the development of carcinoma in the vaginal vault after panhysterectomy for non-malignant disease, is not unknown; Delbet [36] and Quenu [19] have each reported such an occurrence, the latter author having observed two examples. The comparative rarity of carcinoma of the cervix after supravaginal hysterectomy is probably correctly explained by Faure [37] who in over a thousand cases of subtotal hysterectomy has never observed malignancy in the cervical stump. He says, "I have often examined the cervix after supravaginal hysterectomy; it is almost always small, atrophied, and I am convinced, in a state of epithelial inactivity decidedly unfavorable to the development of cancer." Even among the comparatively few cases reported, a number must be thrown out on the grounds that cancer of the cervix existed at the time of the hysterectomy but escaped detection. Among the thirty-six cases in the table there are at least sixteen, in which it is very improbable that the development of the cancer was truly subsequent. If these cases be dropped, the list is practically cut in half, giving even a better appreciation of the infrequency of the condition.

In the great majority of cases of carcinoma developing in the cervical stump after supravaginal hysterectomy, the uterus had been removed for myomata. A glance at the table is sufficient to convince one of this fact. There are 36 cases in the table, in 26 of which, or 72 per cent., the uterus had been removed for myomata. If we consider only those cases in which the carcinoma which subsequently developed was, in all probability, non-existent at the time of operation, we find that in 63 per cent. the uterus had been removed for myomata. It would seem, then, that the question of "Stumpfkarzinom" resolves itself into a consideration of the etiological relationship of myomata to cancer and a consideration of the technic to be used in removing a uterus containing myomata and not the technic of hysterectomy in general. The cases in which malignancy has developed in the cervical stump after removal of the uterus for pathological conditions other than myomata, are so few compared to the many thousands of supravaginal hysterectomies for these conditions as to be practically negligible. Their percentage of frequency would certainly not exceed and probably not equal that of carcinoma of the cervix in any group of women. As Winter[38] has said, the question of carcinoma of the cervical stump is so intimately associated with the consideration of the combination of myomata and cancer that a discussion of one is incomplete without due notice of the other.

Of late years, a rather extensive literature has accumulated indicating the frequency of cancer of the uterus associated with myomata. Dr. Noble,[16] in discussing Currier's paper at the meeting of the American Gynæcological Society in 1906, drew attention to the fact that the evidence at hand, that the presence of fibroid tumors of the uterus led to cancer, was overwhelming, and in the same year reported 8 per cent. of cancer in his last hundred cases of myomata of the uterus. Winter[38] has published some statistics very interesting in this connection. To his lists below, I have added the figures reported by Dr. Noble and Dr. Cullen.[39]

FREQUENCY OF CANCER OF THE UTERUS WITH MYOMATA.

Hofmeier	445 cases of myomata uteri	17 cases
Winter	753 cases of myomata uteri	23 cases
Noble	1188 cases of myomata uteri	41 cases
Cullen	1400 cases of myomata uteri	43 cases
Total	3786 cases of myomata uteri	124 cases

Of 3786 cases of myomata of the uterus 124 cases, or *slightly over three per cent.*, showed cancer of either the body or cervix. No reliable statistics of the absolute frequency of cancer of the uterus exist, but to place it at three per cent. would be absurd. The assertion that myomata exert an influence favorable to the development of cancer of the uterus is therefore incontestable. This influence is even more clearly demonstrated when we compare the relative frequency of cancer of cervix and body of the uterus, when these conditions exist alone, to their relative frequency when associated with myomata. Of 2513 cases of cancer of the uterus reported by Hofmeier, Krukenberg, Freundsen, Küstner, Winter and Cullen, 186 cases, or 7.4 per cent., were carcinoma of the body. On the other hand, of 215 cases of cancer of the uterus, in association with myomata, reported by Hofmeier, Martin, Geuer, Winter (Berlin), Winter (Königsberg), Noble and Cullen—134 cases or 62.3 per cent., were cancer of the body. This remarkable contrast of the relative frequency of carcinoma of the body of the uterus, alone and in association with myomata, can only be explained by the assumption that fibroids bear a definite etiological relationship to cancer of the body of the uterus.

The question now arises as to whether the cervix, in a measure, also shares the tendency to become cancerous in the presence of myomata. Is the absolute incidence of carcinoma of the cervix increased when associated with fibroids of the body of the uterus? The question is answered in the affirmative by Winter,[38] who reports 25 cases of cancer of the cervix occurring among 1270 cases of uterine fibroids; about *two per cent.* He says in this connection, "There can not be the slightest doubt that even in those regions where carcinoma is most abundant an absolute frequency of carcinoma of the cervix of two per cent. is not in the remotest degree attainable." Again, Richelot[20] has pointed out that the general hypertrophy of the endometrium accompanying myomata of the body of the uterus is shared by the cervical epithelium; so that if this tendency to carcinomatous degeneration be directly attributable to active epithelial proliferation on the part of the uterine mucosa, there is sufficient ground for the assumption that the incidence of carcinoma of the cervix would likewise be increased. The fact that nearly three-fourths of the cases of carcinoma of the cervix, following supravaginal hysterectomy, thus far reported, have occurred after removal of the uterus for myomata, is strong presumptive evidence of some definite etiological association of the two conditions.

In a number of cases operated on for uterine fibroids an early carcinoma of the cervix has been discovered more or less by accident. Landau[40] and Küstner,[41] according to Winter, have each had such an experience. Landau, while doing an abdominal myomectomy, discovered a small carcinomatous plaque in the depths of the cervix. Küstner found an early carcinoma of the cervix at autopsy in a woman who had died after a supravaginal hysterectomy for fibroids. Dr. Cullen[39] reports a case of great interest in this connection: Vaginal hysterectomy was performed, an interstitial myoma 3 x 3 x 2 cm. being found in the uterus. In the course of the routine laboratory examination of this specimen, there was found the earliest squamous-cell carcinoma of the cervix he had ever seen. In speaking of this case, Dr. Cullen says: "Had an abdominal supravaginal hysterectomy been done instead of total vaginal hysterectomy, we would ere long have had a well marked carcinoma of the cervix, and would have classed it as a carcinoma developing in the cervix after removal of the myomatous uterus, whereas the growth though clearly present at the time of operation, would have been overlooked." There can be no doubt, that in many, perhaps in half, of the cases listed in the table above, the carcinoma, though reported as having developed subsequently, was in reality present at the time of operation.

It is to such cases as those reported by Landau, Küstner and Cullen that attention should be drawn, as they clearly indicate the necessity for great watchfulness on the part of the operator, when dealing with uterine fibroids. Landau's case is particularly instructive as it would seem to suggest a procedure which if carried out as a routine in performing supravaginal hysterectomy for fibroids, would occasionally reward the operator by the discovery of an unsuspected carcinoma of the cervix. For a number of years Dr. Kelly[42] has made a practice of "cupping out" the cervix after supravaginal amputation of the uterus so that a better closure of its sectioned surface may be effected. Of this procedure, he says: "It is occasionally of considerable advantage to cup out the cervix, dissecting out its mucous canal deep down toward, or into, the vagina. This step in the technic, involving a thorough enucleation, has recently been elevated to the dignity of a method by the distinguished London surgeon, Bland Sutton." The technic is simple, and adds but a moment to the operating time, which is largely compensated by the ease with which the cervix may be afterwards closed over. Should this procedure be employed as a routine in performing supravaginal hysterectomy for fibroids, the advantages would seem to be considerable: (1) The cervix could be more easily closed over. (2) A carcinomatous focus deep in the cervix, which would be otherwise overlooked, would be brought to light as in Landau's case. (3) By the removal of a large amount of the glandular portion of the cervix, the chances of subsequent carcinomatous degeneration would be proportionately diminished. It seems almost superfluous to add that, before the abdomen is opened, the cervix should be examined under sight and before closing, the amputated uterus should be laid open and carefully examined for evidences of carcinoma. Bearing in mind that three per cent. of all fibroids of the uterus are associated with cancer, a strict observance of these precautions would seem not only justifiable but of considerable importance.

To Dr. Howard A. Kelly, I wish to extend my thanks for suggesting the subject of this paper and for permission to report the two cases noted, which occurred in his clinic at the Johns Hopkins Hospital.

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SACROCOCCYGEAL TUMORS.

WITH A REPORT OF A LARGE TERATOMA.

BY ROBERT OLLERENSHAW, F.R.C.S.(Eng.), M.D., B.Ch.(Vict.),
Surgeon to Children's Dept. Manchester Northern Hospital;
Surgeon to Salford Royal Hospital.

The tumors of the sacrococcygeal region provide the most interesting and complicated collection of developmental errors of any region of the human body, so that before recording the details of a case which came under my care early this year it will perhaps help to make clearer its pathogenesis if the account is prefaced by a few words regarding the development of the caudal end of the embryo. Apart from neoplasms, such as lipomata, angiosarcomata, and lymphangiomata, which have no characters peculiar to this region, and leaving aside spinal defects, anterior and posterior spina bifida, spina bifida occulta, and the congenital dorsisacral herniæ, the congenital tumors of the sacrococcygeal region may be classified best into four chief groups: (1) caudal appendages; (2) dermoid cysts; (3) mixed tumors; (4) fetal inclusions.

1. *Caudal Appendages.*—These are of two types: true tails and pseudotails. The former consist of new growth of cartilage and bone or are definite prolongations of the sacrum.[1] The false tails are due to persistence of the caudal filament, or may be caused by the presence of a tail-shaped lipoma. False tails contain no bone.

2. *Dermoid Cysts.*—These may exist as sinuses or as simple dermoid cysts, and frequently contain collections of hair. They are found in the middle line of the body at the lower end of the sacrum and coccyx between the buttocks. Irritation and inflammation in adult life may be the cause of their being noticed at that time, although they have been present since birth. Their presence has been accounted for by various theories: incomplete closure of the medullary

canal,[2] a dimple of the skin bound down to the coccyx,[3] etc.

3. *Mixed Sacrococcygeal Tumors.*—These growths present an extremely complex structure and have been found to contain the following elements:[4] cysts of varying size lined by simple or stratified epithelium, polymorphous and sometimes ciliated; glandular epithelial collections; bone and cartilage; striped and smooth muscle; nerve tissue; fat, etc., all mixed together in a conglomerate mass in a connective-tissue framework (Figs. 4 to 8).

Von Bergmann, Braune and Lotzbeck consider that these tumors are monogerminal—arising from the hyperplasia of a group of organs belonging to the subjects to which they are attached.

The various transitory organs appear to be able to give rise to the neoplasms, each to that portion which concerns it. The transitory structures in question are: (*a*) caudal medullary tube; (*b*) primitive streak and neurenteric canal (Von Spee and Hildebrand); (*c*) postanal gut (His); (*d*) chorda dorsalis; (*e*) coccygeal gland. Förster, Virchow, Bonnet, and others consider these tumors to be, on the other hand, of bigerminal origin and so to represent a second individual in a more or less rudimentary condition.

4. *Fetal Inclusions.*—When the bigerminal formation is complete we have the double formation—for example, the Siamese twins. When incomplete, as is more usual, an arm, a leg, or a foot is attached to the sacrum and part is included under the skin.

My own case, which I now wish to report in some detail, belongs to the third group; it is a monogerminal mixed tumor and is of the cystic type.

The cystic mixed tumors are by far the most commonly found class. The size is variable; it may be from the size of an orange to that of a child's head—it rarely exceeds the latter size. The tumor may not grow at all after birth or may grow slowly. Rectum, bladder, and genitals may be much displaced and their functions interfered with, particularly if the tumor projects forward toward the perineum as it did in my case. The surface of the tumor is smooth and regular over the larger cysts in contrast to the more nodular surface over the smaller cysts and solid portion. The swelling is soft, fluctuant, and translucent.

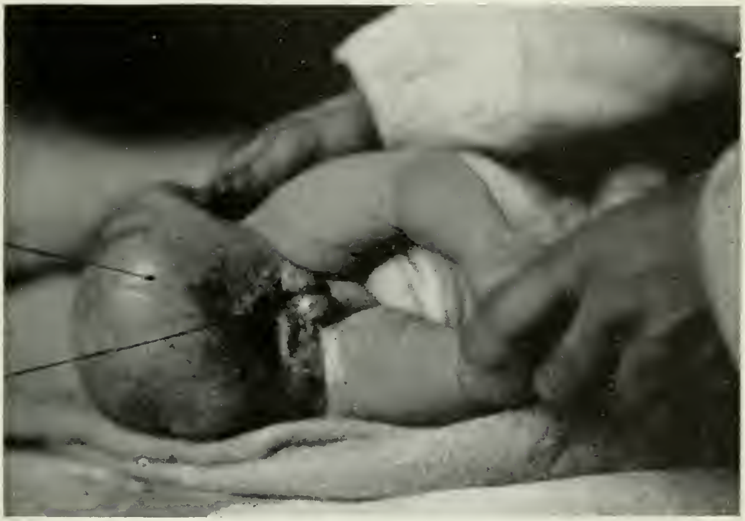
REPORT OF CASE.

A female infant, four days old, was sent to me, at the Manchester Northern Hospital, by Dr. Kyle, of Oldham. It was the fifth child of the family; the parents did not know of a deformity of any sort among their relatives, immediate or remote. Apropos of the bigerminal theory in relation to this class of tumors, it was ascertained that the only history of plural birth in the family was the case of the infant's paternal grandmother, who was herself a twin. Previous to the child's birth the mother said she could feel, on careful abdominal palpation, what she took to be two fetal heads, and when the child was born a swelling almost as big as its head was found in the perineal region.

It was said to have undergone no change during the four days which elapsed before I saw it, and the tumor, which was then roughly the size of the child's head, was, as the photograph (Fig. 1) shows, projecting from the sacrococcygeal region and apparently separating the glutei muscles of the two sides and chiefly projecting to the left. The tumor also extended forward to the perineum so that the anus was displaced downward and came to open directly forward.

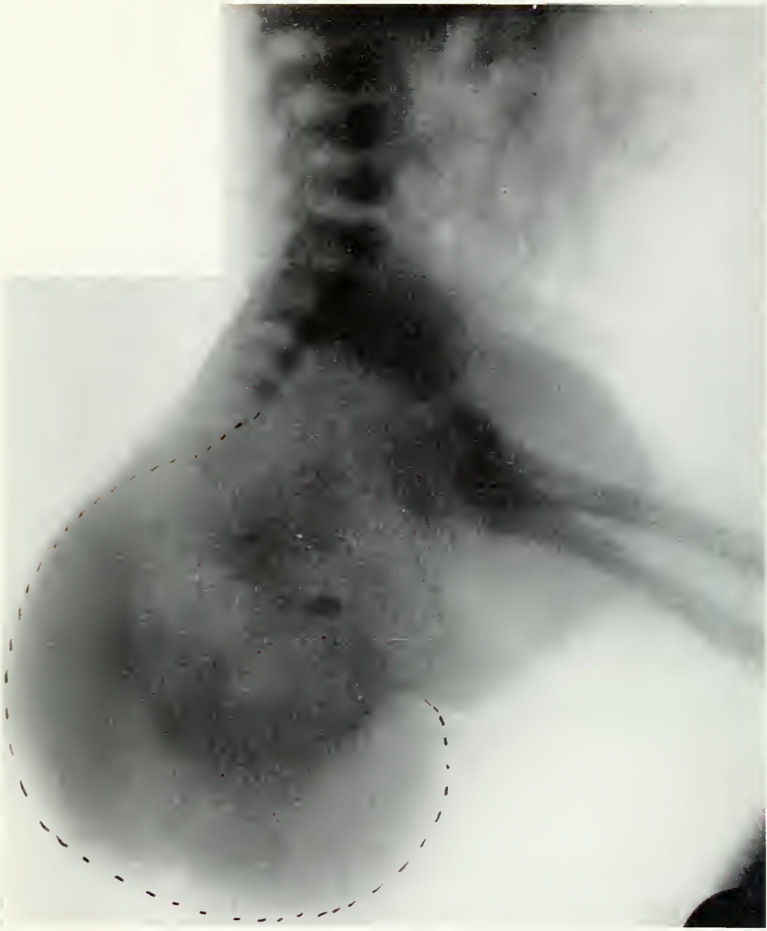
The most prominent and dependent part of the swelling was covered by tense, shiny skin, which obviously enclosed a large collection of fluid. The upper part of the growth close to the coccyx was much firmer in consistency, and felt as though the coccyx, much enlarged, were continued down into the tumor. The general condition of the child was fairly good—on admission there was some diarrhœa (it had been bottle-fed) and the motions were so irritating as to have caused a good deal of soreness round the anus. There was no paralysis nor malformation of the legs. Micturition and defecation were not interfered with. It was found also that pressure over the cyst had no effect on the prominence of the anterior fontanelle. After sterilizing the skin the needle of a large exploring syringe was inserted at the most prominent point of the cyst, and several ounces

Fig. 1



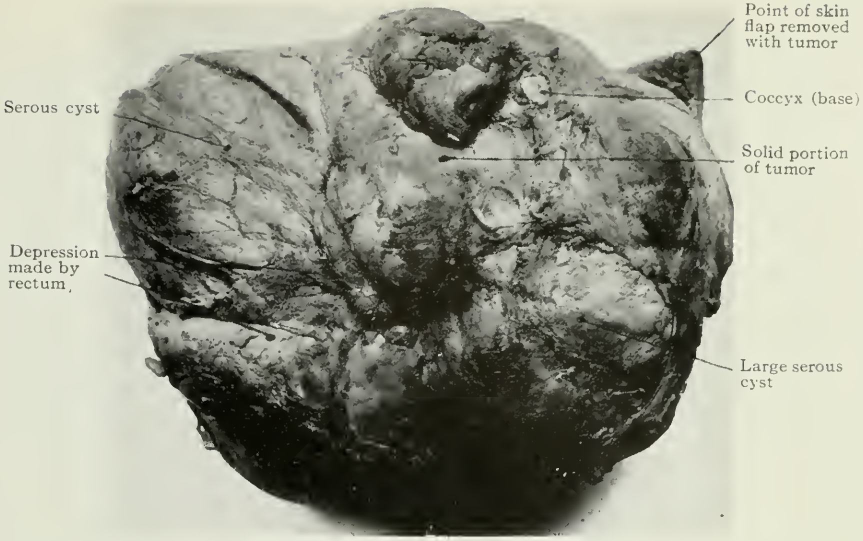
To show ventra aspect, relation of anus etc.

FIG. 2.



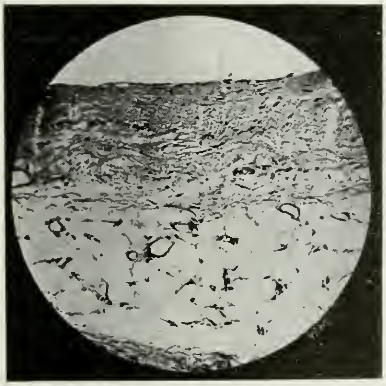
Lateral skiagram. Tumor outline dotted.

FIG. 3.



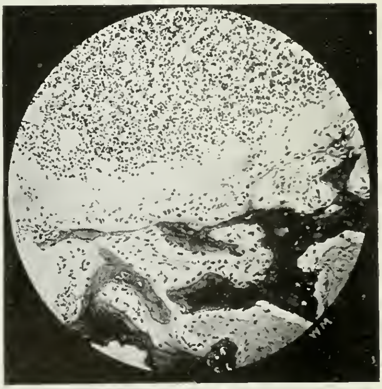
Sacrococcygeal tumor (deep aspect).

FIG. 4.



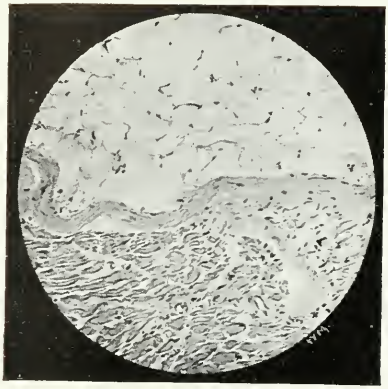
The cyst wall (fibrous) with adipose tissue (× 175 diameter).

FIG. 5.



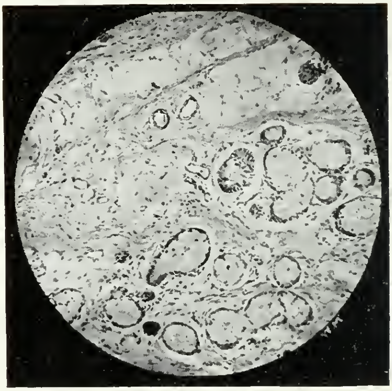
Bone and bone marrow (× 40 diameter).

Fig. 6.



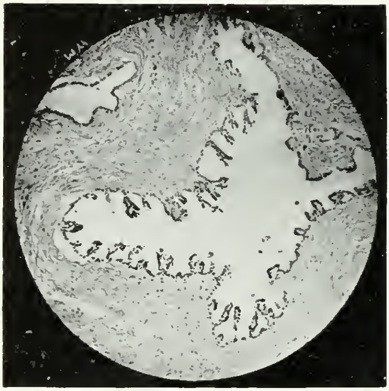
Striped muscle and adipose tissue (×175 diameter).

Fig. 7.



Glandular tissue, probably salivary gland (× 75 diameter).

Fig. 8.



Columnar epithelium, probably rudimentary stomach (× 40 diameter).

of serous fluid were allowed to escape. After this had been done it became apparent that the cystic part of the tumor was multilocular and a second smaller cyst was tapped.

The solid element could now be examined more carefully; it was found to be about one and a half inches long and one inch across. Per rectum it could be felt running down behind the rectal wall commencing at the coccyx which felt much thickened. The fluid collected from the cysts proved to be simply serous and not cerebrospinal.

The diagnosis of sacrococcygeal tumor was made, and it was decided that removal should be attempted. As the operation was obviously to be of a serious nature it was postponed for a few weeks till the child should be in better physical condition. In the interval the skiagram (Fig. 2) was taken.

Operation.—To diminish shock the child was enveloped in a cotton wool suit which left exposed merely the head and the field of operation. Ether anæsthesia. Very little hemorrhage occurred. The growth was separated with little difficulty except where the rectum was in close apposition, and while dissecting in this situation a soft bougie in the rectum was of considerable assistance. The tumor (Fig. 3) after removal proved to be about six inches in length, four and a half inches across, and about the same depth. On the deep attached surface the coccyx ran directly into the solid growth and it was necessary to remove it with the growth.

The child made a surprisingly good and complete recovery; some little ingenuity and very frequent attention were required to ensure clean healing of the extensive and awkwardly situated wound.

The most successful treatment is undoubtedly radical excision as early as possible, so as to diminish the risk of thinning of the cyst wall and subsequent infection.

Palliative means, such as tapping, injection of irritants, etc., have frequently resulted in septic infection and death.

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PURPURA OF THE BLADDER.

REPORT OF A CASE WITH A DESCRIPTION OF THE CYSTOSCOPIC APPEARANCES.

BY FRANK KIDD, F.R.C.S.,
OF LONDON,
Assistant Surgeon to the London Hospital.

Report of a Case.—Selina H., aged twelve years, was admitted to Sophia Ward, London Hospital, Nov. 30, 1910, with the history that on Nov. 29 at 8 p.m. she felt a sudden desire to pass water and during the act experienced a sharp stabbing pain starting in the left iliac region and spreading into the vulva. Between 8 p.m. and 9.30 p.m. she passed water four times, each time noticing a similar pain which lasted only as long as water was passing and ceased at once at the end of the act. At 9.30 p.m. she passed water again and this time inspected it. It was full of blood. An aching pain came on in the left iliac region when she went to bed and lasted all night and the whole of the next day. Urine was passed once in the night and five times during the next day up till the time of admission into the hospital at 5 p.m. on Nov. 30.

Previous Health and Habits.—Diphtheria five years ago, otherwise no serious illnesses. No hæmophilia. No scurvy. The patient lives in Poplar amidst poor and unhealthy surroundings. She has had a sore throat for some days before the onset of the hæmaturia and has felt "out of sorts."

Examination.—The patient looks ill and is pale and anæmic. The temperature is normal. Pulse and respiration rate normal. Tongue clean and moist. Heart, lungs, and alimentary system normal. There is follicular tonsillitis on the left side and some slight enlargement of the glands on the left side of the neck which are tender to the touch. The skin shows no petechiæ.

The gums are healthy. There is deep tenderness over the bladder region, especially on the left side. The urine is full of blood clots and contains bright red blood diffused throughout. The patient was at once taken into hospital and put to bed. By the next morning the bleeding had disappeared and the pain had ceased.

Further examination elicited the following facts:

1.12.10. X-ray examination of the bladder and kidney areas showed an absence of stone shadows. Urine clear to the naked eye, 38 ounces in 24 hours. Reaction acid, specific gravity 1021, no albumin, urea 2.5 per cent. Hæmorenal index (electrical resistance of urine and serum) 1.5 (normal 2).

2.12.10. Cystoscopy. The bladder was filled with 8 ounces of oxycyanate of mercury solution 1/4000. Both ureters appeared healthy. The bladder wall for the greater part appeared pale and healthy, but scattered irregularly over fundus and trigone were seen patches of submucous hemorrhages varying in size from a pin's head to a sixpence. The patches were of all shapes and sizes, some linear, some stellate. The greater number were scattered over the fundus. There was no ulceration and no sign of miliary tubercles. I came to the conclusion that I was either dealing with a purpuric condition of the bladder wall or that I had caught a primary blood infection of tuberculosis at its very onset.

On December 5th and again on the 6th a 24-hour specimen of urine was examined for tubercle bacilli and for pus cells. None were found. A " Von Pirquet " tuberculin reaction was done and was positive.

The urine remained clear till December 9, when another attack of pain and bleeding came on exactly similar to the first one. This lasted two days and then cleared up completely. Throughout the whole time the patient was in the hospital the temperature remained normal, and there were no signs of constitutional disturbance except that the patient felt below par.

15.12.10. No pain, no increased frequency, no blood for 4 days. Cystoscopy. The picture has changed completely. The bladder is quite healthy again save for three faint patches like fading bruises on the walls of the fundus. There is also a small fading patch of hemorrhage about one inch above the middle wall of the bar of Mercier into which a small blood vessel is seen to run and be lost.

16.12.10 Blood examination. Coagulation time 5 minutes. Red blood corpuscles 5,000,000. Hæmoglobin 85 per cent. Color index 0.8. White cells in normal proportions. Calcium lactate (10 grains three times a day) was administered for a week and the patient left the hospital on Dec. 19, apparently completely cured and restored to health and has had no return of the bleeding up to date.

I regret I did not have the blood and throat cultures made and the coagulation times of the blood taken during the first week of the illness, but at the time I thought I was dealing with a case of tuberculosis of the bladder, and it was not till I had excluded this that I became convinced that the case must be considered as one of a purpura of the bladder mucous membrane.

This case is of interest from two points of view—that of urology and that of general pathology.

As regards the first, though many cases can be found in the literature of purpura accompanied by hæmaturia, yet I have been unable to find any case where cystoscopy has been performed and a description of the condition given, nor where the purpuric eruption has been proved to be confined to the bladder alone.

Urological literature is also full of unexplained cases of renal hæmaturia. Such cases may be mild single attacks or may be severe and relapsing, and certain authors have reported cases where one kidney has been removed for this condition and though submitted to minute microscopic examination nothing has been found to account for the bleeding. It is conceivable that some of these cases should be classed under the heading of purpuras in which the purpuric eruption has occurred only in the kidney. It seems fair to argue thus by analogy from the case just described where the purpuric eruption was proved to be confined entirely to the bladder. *Cystoscopy in the above case proved that an appearance may be met with in the mucous membrane of the bladder exactly resembling a purpuric eruption on the skin which clears up like a simple purpura and which may be unaccompanied by any other sign of hemorrhage either into the skin or into any other mucous membrane or part of the body.*

That a purpuric condition can reveal itself by means of intestinal pain and intestinal hemorrhage unaccompanied or not accompanied at first by purpura of the skin has been brought home by recent reports of cases of intestinal hemorrhages simulating or leading to intussusception. There is therefore sufficient clinical evidence to prove that an agent capable of producing a purpuric eruption can be circulating in the blood and can be thrown out into any single one of various situations, such as the intestine or bladder, without being thrown out into the skin at all.

The case is also of interest from the pathological standpoint. So long as the attempt was made to class purpuras on purely clinical grounds as separate entities so long the subject was in a state of confusion. A purpuric eruption, whether of skin or mucous membrane, must be considered as a symptom not as a disease. Such an eruption must be due to solutions of continuity in the walls of capillary blood-vessels with a result that blood escapes into the tissues.

When we inquire how this solution of continuity can arise we are not always able to detect a cause. When we cannot, we speak of primary purpuras, when we can we speak of secondary purpuras. We will discuss the secondary purpuras first.

The simplest cause is the mechanical weight of the blood which gives rise to that common form of purpuric eruption seen in those who rise from bed after a long illness. Again in patients who suffer from excessive blood-pressure such an eruption is sometimes seen. Certain chemical poisons are known to be able to cause such an eruption, as for instance chloral, iodoform, arsenic, quinine, the balsams, salicylates, potassium chlorate, mercury, phosphorus and lead; and the eruption of scurvy is probably due to a chemical alteration of the blood brought about by deficient ingestion of vegetable salts.

Again certain chemical poisons can arise within the body and give rise to purpuric eruptions such as have been described in nephritis, cirrhosis of the liver, in the cachexias, in pregnancy and in diseases of the blood.

But the most interesting group of all is that of the purpuras set up by the actions of micro-organisms or their poisons on the walls of the capillaries. Micro-organisms have been found in purpuric lesions and it is well known that any of the acute specific fevers may be met with in a hemorrhagic form. But in many cases the eruption may be caused by the toxins of the bacteria as the bacteria have been found in the blood and not in the lesions, or have been found only in some local focus, as for instance in a diptheritic or streptococcal pharyngitis or in a local tuberculous lesion.

At first sight the eruption in this case appeared as though it might be a manifestation of the onset of tuberculosis; the "von Pirquet" tuberculin reaction was positive, and the case seemed to fit in very well with the descriptions of tuberculous purpura given by Bérard et Roubier, *Gaz. des Hospitaux,* 1907, lxxx, 1635–1671. They described three forms of purpura occurring in the course of tuberculosis.

1. A pre-tuberculous purpura which is the first sign of the onset of tuberculosis, hypothetically due to the circulation of tuberculin in the blood. In this connection it is interesting to note that a number of cases of tuberculous kidney have as an onset symptom a profuse painless hæmaturia.

2. A form of purpura which appears during the course of a frank tuberculosis and hypothetically due to secondary infection of the tuberculous foci.

3. A form seen during the terminal cachexia.

This hypothesis was rejected on the following grounds: no tubercle bacilli could be found in the urine, and the case has not gone on to tuberculosis of the genito-urinary tract. A second hypothesis seemed more acceptable, namely that the hemorrhagic eruption was due to the absorption of bacterial toxins from the throat. The child had a definite follicular tonsillitis on the left side and the glands of the neck were swollen and tender. Unfortunately no cultures were made of the throat. Certain bacteria have been proved to be capable of producing poisons which can cause hemorrhagic eruptions, for instance the streptococcus by Klein, the bacillus of Friedlander by Oliver, the typhoid bacillus by Andrewes. I have myself observed a case of erysipelas which proved fatal from hemorrhage into the stomach and duodenum. How does the body eliminate bacteria and other poisons? The main channels are undoubtedly the kidney, the skin, the bowel, the liver and to a less extent the lungs. Originally the cœlom was the space into which poisons were excreted and were got rid of by means of the primitive nephridia.

The cœlom is nothing but a large connective space. Any large connective tissue space can apparently be made use of by Nature into which to pour out substances harmful to the body. In such spaces these bodies can be localized, diluted, neutralized and finally, when neutralized, be absorbed back into the blood as harmless substances. Such spaces are the joints, bursæ, serous spaces and aponeuroses and these may be looked upon as the " dustbins " of the body and by being used as such a second purpose is attained. Inflammation of such spaces may cause such pain that locomotion is impossible and recumbency is thus forced upon the victim of a severe infection.

Absolute recumbency is of the utmost importance in recovery from such an infection, as by that means it is possible to diminish the amount of poisons absorbed from the local focus, whereby the defensive mechanism of the tissues is not overwhelmed but is stimulated to produce sufficient antibodies to overcome the invading host.

In the same way it is tempting to think that the bladder may still retain traces of its origin. The bladder is developed from the allantois which was once part of the excretory organ of the fœtus.

It is permissible to suppose that in certain persons the bladder has not entirely lost its excretory function, and hence a bacterial poison circulating in the blood might be thrown out into the mucous membrane of the bladder and nowhere else. Anyhow such an hypothesis is a very tempting one.

If the hypothesis of a purpura secondary to a tonsillitis be rejected this case must be classed under one of the primary purpuras. Bérard and Roubier give three primary purpuras, namely purpura rheumatica, infective purpura and Wehrlof's purpura.

Purpura rheumatica is ushered in by prodromal symptoms, malaise, pains all over the body and fever. These are soon followed by a purpuric eruption, joint pains and effusions, gastro-intestinal pains and hemorrhages, slightly albuminous and sometimes blood stained urine. The disease runs a course of from two to eight weeks and is followed as a general rule by complete recovery.

Infective purpura is of a severe typhus type and death is almost invariable.

Wehrlof's purpura is met with in children from five to fifteen years of age, chiefly in females. There are no prodromal symptoms, no malaise, no fever, no pains all over the body. Recovery is the rule. There is an acute form which is all over in a fortnight, and a chronic relapsing form which may last much longer. Hæmaturia has not been described.

The case reported above fits in most closely with the descriptions of Wehrlof's purpura, but seeing that hæmaturia has not been described in this form of purpura it does not exactly tally.

Summing up I am inclined to think that this case was one of secondary purpura confined to the bladder and arising in a bacterial infection of the tonsil though it is possible to look upon it as a case of Wehrlof's purpura.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, held at the New York Academy of Medicine, March 12, 1913.

President, DR. CHARLES L. GIBSON, in the Chair.

CHRONIC MASTITIS WITH CARCINOMA.

DR. PARKER SYMS presented a woman, thirty-nine years of age, who gave the following history. About eight years ago, after the birth of her only child, she had " caking " of the right breast. There was no abscess. After this there remained a permanent localized swelling of the gland.

On December 31, 1912, she was admitted to Lebanon Hospital on account of this swelling and on account of the fact that there had been some recent increase in its size and some slight pain in the breast. When Doctor Syms examined her he found a typical condition of chronic mastitis or abnormal involution of the right breast with a distinct tumor in its upper outer quadrant.

Believing that such a condition is a precancerous state or at least is potential of cancer, and believing that it is impossible to make any differential diagnosis in these cases, Doctor Syms did the radical ablation of the breast, pectoral muscles and lymphatics after the method of Willy Meyer, on January 15, 1913.

The specimen was submitted to a competent pathologist who made sections of the same and reported the condition to be one of simple adenofibroma with no evidence of cancer. Some weeks afterward, at Doctor Syms request the same pathologist made many sections of the specimen and finally he ran across one from which he made the diagnosis of cancer.

Doctor Syms said that he presented this case as one of particular interest and of great value because it emphasizes certain important points.

First, it emphasizes the fact that this condition of abnormal involution or chronic mastitis (with the production of masses, which histologically may be classed as fibro-adenomata or adeno-fibromata) is a very important factor in the development of cancer and must therefore be considered as a precancerous condition or stage.

Second, it illustrates the fact that in these cases cancer may begin in one part of the gland while such a change may not be found in any other part of the gland.

Third, it emphasizes the fact that the detection of such a cancerous change may require the examination of many sections.

Fourth, this being true, it is evident that diagnosis by means of the frozen section must be subject to error in a certain proportion of cases.

Doctor Syms has always maintained that reliance on the frozen section is not justifiable in these cases. In this particular case examination of several sections of the hardened specimen in the laboratory failed to reveal the carcinoma. How much less reliable would have been a hastily made examination of a frozen section!

TUBERCULOSIS OF THE BREAST.

Dr. John A. Hartwell reported the case of a married woman, twenty-three years old, a native of Roumania, who gave no family history of either tuberculosis or cancer. She had one child, eighteen months old, which she had nursed for one year. Six weeks ago she first noticed a large, hard lump in the right breast, which at one time was markedly reddened and extremely tender. This was treated at a dispensary with a binder and massage, and had gradually decreased in size. About two weeks ago she began to have pain in the wrist and legs, about four inches above the ankle joint. These areas became red and tender; she felt feverish and was unable to walk because of the pain. During the past fortnight she had been unable to do her housework, and had suffered from marked anorexia. Her chief complaint was swelling in the right breast, and swelling and pain in both legs between the middle and lower thirds.

Examination of the joints and skin showed a rheumatic inflammation, which apparently had no connection with the breast lesion. There was no evidence of tuberculosis in the lungs or other organs aside from the right breast, which was the seat of a subacute, inflammatory process involving the whole inner quadrant, the mass thus formed measuring about 10 x 15 cm. in extent. The overlying skin was reddened, and at one point near the nipple it was on the verge of ulcerating. On palpation, the mass was irregular in outline; it involved the breast tissue in its entire thickness, and was adherent to the skin but not to the muscle. In consistency it varied from a very hard, inflammatory character to a fluctuation at the point where the skin was most reddened. There were areas of boggy swelling scattered through it, which were quite tender in some parts; in others, non-sensitive. There was one moderately enlarged gland, slightly tender, in the axilla.

The patient objected seriously to a complete removal of the breast, and accordingly, only the diseased area was removed. Primary union followed. The enlarged gland in the axilla was not excised, and a month after the operation it was no longer palpable.

Upon gross examination it was found that the excised portion of the breast was the seat of a chronic inflammatory process, with several small, suppurating foci. There were no evidences of cheesy necrosis: in parts, the exudate was of an almost stony hardness, but in many it was quite soft. The area immediately beneath the most inflamed point in the skin was broken down into an abscess, with moderately thick pus and ragged, necrotic walls. The clinical history of the case and the gross appearance of the specimen suggested tuberculosis, but a positive diagnosis was not possible. Microscopic examination, however, showed typical miliary tubercles, with giant cells and central necrosis. Section stained for tubercle bacilli demonstrated the organism.

BILATERAL CYSTIC DEGENERATION OF THE BREASTS.

Dr. W. S. Schley presented a woman, single, fifty-two years old, who was admitted to the hospital on February 16, 1908, complaining of trouble with her breasts. Examination showed that the breasts were rather small and flattened, firm, non-tender, and both contained numerous small and large nodules. A number of the larger ones were punctured and a clear fluid was withdrawn.

While the process was recognized as essentially a benign one, the possibility of overlooking a cancerous cyst was considered. Both breasts were removed by the old marginal incision—sometimes called Thomas's incision—preserving the nipple and integument in compliance with a request for a cosmetic result. The appearance of the breasts was very good from that standpoint, and the scars were scarcely appreciable.

DIFFUSE ADENOFIBROMA OF BOTH BREASTS.

Dr. Schley presented a woman of forty-five who was admitted to the hospital on February 27, 1913. She was married, but had had no children. Her mother died at the age of fifty-eight with "cancer of the glands of the neck."

The patient complained of some hardening of the left breast, with occasional stabbing pains and some swelling. Her observation of the condition began three weeks before her entrance to the hospital, when she noticed that the breast seemed slightly swollen and tender, but without redness or signs of inflammation. Upon examination, the left breast showed marked thickening of the tissues under the nipple and in the lower and outer quadrants, with slightly fuller outline. This area was moderately tender. There was no retraction of the nipple nor palpable axillary glands. The feel was that of matted and enlarged glandular elements, and a diagnosis of adenofibroma was made. Frozen sections at the time of operating confirmed this diagnosis, and a full third of the breast was removed.

The right breast showed a similar condition, but the area of induration was more limited. Nothing had thus far been done with this breast, but the patient was being kept under observation.

Dr. Schley said the practical questions to decide in dealing with benign conditions of the breast was in which of them were malignant changes likely to occur, which could be treated by local excision, and which were better off with removal of the breast? Most of these patients were over 40 years of age, a time when we looked for malignant changes. The simple cystic conditions, with single or multiple cysts, were distinctly benign and required only local excision unless associated with adenomatous hyperplasia or the parenchymatous hypertrophy of Bloodgood. Adenomatous changes, whether of the adenomafibroma or the adenocystic type, were suspicious, even if the epithelium had not dipped beneath the basement membrane, and if associated with parenchymatous hypertrophy to any extent, the removal of the breast was wise. We had come to a more careful gross differentiation of breast tumors, with or without the aid of frozen sections, which had led to a somewhat more conservative surgery. We should not place too much reliance on the frozen sections, even if they were nearly perfect, as the excised portion may not have come from the particular part where the epithelial changes existed. Over-conservatism might be even more undesirable than radicalism, and a combined surgical and pathological experience in gross as well as microscopic anatomy was necessary in the conservative handling of breast growths. In doubtful cases the removal of the breast was certainly advisable, as none could gainsay the ultimate safety thus assured. After partial excision, cysts and adenomata sometimes developed in the remainder of the gland. Bloodgood, in 1909, declared that he had never seen cancer develop in any of the breasts treated by local excision at the Baltimore clinic.

EPITHELIAL CHANGES IN CHRONIC MASTITIS, AND THEIR RELATION TO THE DEVELOPMENT OF MAMMARY CARCINOMA.

Dr. Burton J. Lee read a paper with the above title.

Dr. Hartwell said the paper of Dr. Lee was most timely in more than one respect, as it definitely called our attention to a condition which actually existed, and to the changes which took place in the transformation of benign into malignant lesions. Every pathologist was aware of this fact and the frequency with which it was overlooked in surgical work. Dr. Hartwell said he had recently reviewed the subject of cancer for a paper which he was writing, and he had found an appalling number of cases which were seen by clinicians or surgeons, who had temporized with them in spite of the fact that they were already malignant or soon afterward became so.

In dealing with a chronic mastitis, the possibility of a malignant change was especially important. In the case of Dr. Hartwell's, reported by Dr. Lee, the breast was evidently the seat of a chronic mastitis, but there was one area, not localized, but quite hard and very suspicious of carcinoma. He did a radical operation, and Dr. Ewing examined many sections without being able to prove that it was carcinoma. He reported that it was a chronic mastitis with changes that would have gone on to carcinoma. Subsequently, he found evidences of actual carcinomatous changes. In the other breast a focus which was positively malignant was also found.

There was no question, the speaker said, that breasts of this type should be removed in their entirety, as they offered a beautiful illustration of an inflammatory condition undergoing malignant degeneration.

Dr. Schley, speaking of tuberculosis of the breast, said that in a review of the subject in 1903 he had found 304 cases recorded in the literature. Since then perhaps twelve or fifteen more had been reported. Dr. Powers, of Denver, in his last article, reported two new cases, and Dr. Schley said he had recently seen two in which the breast infection was secondary to tuberculosis of the ribs. The infection in these cases was either hæmatogenous or by way of the lymphatics or nipple. Dr. Powers had only seen four cases in his own experience and Dr. Brill had seen one or two. In most of these cases a spontaneous cure was unknown.

Dr. Chas. L. Gibson said that changes in the epithelium in the carcinomatous age indicated a very dangerous condition, and such conditions at any time were likely to become malignant. After the age of 35 or more, a disturbance of the breast, due to epithelial changes, should be held to be cancerous until proven to be otherwise. It was better to occasionally sacrifice a healthy breast than to allow a woman with a cancer to go unoperated. That, Dr. Gibson said, was the position which he took in his paper on the subject which he read before this Society a number of years ago.

Dr. Lee, in closing, said in reply to a question that while the precancerous condition might be recognized in frozen sections, the difficulty was that such sections were usually taken from one area of breast tissue, whereas sections from different areas should be carefully examined before we could positively exclude precancerous changes or true carcinoma.

UNDESCENDED TESTIS IN A HERMAPHRODITE.

Dr. George Woolsey reported this case and showed the specimen. The patient was a seamstress, twenty-four years old, a native of Austria, who was admitted to one of the female wards at Bellevue Hospital on March 4, 1913, with the diagnosis of hernia. Upon examination Dr. Woolsey found a small tumor in the region of the left pubic spine, which the patient said she had first noticed about two weeks before when she suddenly leaned forward at work and pinched it causing severe pain. On February 24 the pain had become so severe that she had to go to bed, and she had remained there until the time of her admission to the hospital. It gave the peculiar ovarian or testicular tenderness on pressure, and had not increased in size. The tumor gave no impulse on coughing and it was regarded at the time as a hernia of the left ovary. Upon operation, the tumor proved to be a small testis, curled on itself, and upon further exposure the vas deferens was traced up to the inguinal canal, which contained no hernal sac. There was no scrotum into which the testis could be transplanted, and it was thereupon removed.

The external genitals of this patient, including the vestibule, meatus and clitoris, Dr. Woolsey said, were those of the female type, with a much enlarged clitoris. The vagina was smaller than normal, the vaginal portion of the cervix was lacking, and both by vaginal and rectal examination and by combined examination, with one finger through an opening in the peritoneum at the internal ring, no uterus could be felt. A transversely placed structure, feeling like the organ removed, could be felt in the pelvis on the right side of the upper end of the vagina. On either side of the upper end of the vagina could be felt a cord like structure. The vas was traced in to the pelvic brim but it was not possible to palpate its further course.

At the time of the patient's admission to the hospital, her face had the appearance of that of a man's with a dark beard, closely shaven, and at the time of operation there was a distinct growth of hair on the face. This was removed from time to time by rubbing with some kind of stone. The chest was covered with quite a profuse growth of hair. There was no development of the breasts. She had never menstruated, but at varying intervals she had noticed a slight whitish discharge from the vulva, lasting but a few minutes and preceded by a peculiar sensation.

The specimen was reported on by Dr. James Ewing, as follows: "This specimen may be described as an undeveloped but otherwise complete testis. The testicular tissue forms an excapsulated, brownish mass, one-half by one cm. in size, which is attached to a larger mass of fibro-cellular tissue, one by two cm., which contains portions of epididymis and rete testis. On section, the testicular tubules are normal in form and arrangement, though small in size. There are scanty interstitial cells in the stroma. There is no evidence of spermato-genesis. The tubules of the epididymis have normal, large, high, cylindrical, ciliated epithelium. There are many ducts lying in the dense fibrous tissue and containing pus. The surrounding connective tissue is very cellular and extensively invaded by plasma cells and lymphoid follicles."

The patient must therefore be regarded as a male pseudohermaphrodite.

Stated Meeting, held at the Presbyterian Hospital, March 26, 1913.

The President, Dr. Charles L. Gibson, in the Chair.

PYOPNEUMOTHORAX.

Dr. John A. Hartwell presented a man, twenty-three years old, who had an attack of pneumonia in 1910. Aside from this there had been no past illness of importance, and there was nothing to indicate a tubercular infection. He was admitted to the Presbyterian Hospital early in December, 1912, having been sick for six days with the symptoms of pneumonia on the right side.

On admission, the patient looked acutely ill. His breathing was shallow and painful, and he suffered from a severe cough, with dirty brown expectoration. His temperature was 102°; pulse, 102; respirations, 28; leucocytes, 31,600, with 93 per cent. of polynuclears. The physical signs over the right chest were those of a pyopneumothorax, and they were confirmed by aspiration, both pus and air being withdrawn through the exploring needle. No tubercle bacilli were found in the sputum or in the pus, the latter showing long chain cocci in smears, but no growth on culture.

In the absence of any evidence of tuberculosis, and in view of the acute onset, it was believed that the pyopneumothorax followed either a pneumonia or an abscess of the lung. A free opening into the pleural cavity under these circumstances for the purpose of drainage would inevitably result in the complete collapse of the lung, and with the existing perforation in the lung there would be little tendency for the latter to expand, and a chronic empyema would result. Therefore, instead of free drainage, the pus was repeatedly aspirated at intervals of twenty-four hours, and the air was continuously withdrawn by means of a large hollow needle introduced above the fluid line, connected with a tube which was immersed in water in a bottle standing on the floor. By these measures the pleural cavity was kept practically empty, because on coughing any air that was pumped from the lung into the pleural cavity was immediately expelled through the needle and escaped under the water. The water valve prevented aspiration into the chest through the needle. When first inserted, there was a positive pressure which forced air out in considerable quantity; the pressure then sank to zero, and air only flowed when coughing.

The pus aspiration and the equalization of the air pressure was kept up in this way for one week, during which time the patient's general condition was much improved, the temperature, pulse and respirations dropping to normal. During the last three days of this period there was much of the time a negative pressure shown in the chest cavity by the sucking of the water up into the tube for a distance of ten cm. or more. This demonstrated that the perforation in the lung was growing smaller, and that some expansion of the lung was possible.

Under local anæsthesia, half an inch of the eighth rib was resected in the axillary line, and a self-retaining rubber bobbin was inserted through a small hole in the pleura. A tube was passed through the bobbin and connected with the suction bottle. In this way all of the pus was withdrawn, much of it having been too thick to flow through the needle, and the suction expanded the lung without evidence of opening, to any extent, the hole in the lung. By means of the snugly fitting bobbin, air was prevented from entering the chest through the pleural opening, and a clamp on the tube closed this means of entrance. Each day suction was applied to the tube, and in the intervals the tube was kept closed. The chest was thus kept empty of pus, and a certain amount of negative pressure maintained which resulted in a gradual expansion of the lung. All evidence of air passing into the pleura from the lung ceased in about two weeks, and thereafter the condition was treated by simple drainage. Four weeks after the operation the discharge had entirely stopped, and the wound was completely healed.

From the physical signs it seemed that the expansion of the lung was very incomplete, but there was no evidence of either fluid or air in the pleural cavity, and suppuration had entirely ceased. The patient's condition was satisfactory at the present time, two months after leaving the hospital.

This method of treatment, Dr. Hartwell said, had been followed in a second case of pyopneumothorax following pneumonia, with an equally satisfactory result. The principle underlying it was that the chest cavity was not opened until the perforation in the lung was sealed, and during the interval required for this, the mechanical compression of the lung and the ill-effects of the suppuration were minimized by the negative pressure maintained and the frequent withdrawal of the pus. Presumably, the closure of the lung perforation took place by its becoming adherent at the site of the opening rather than by an actual healing, though the latter took place subsequently. It was impossible, however, to completely clear up the infection by simple aspiration, and ultimately a thoracotomy had to be done, but the principle of suction had to be maintained even then.

TUBERCULOSIS OF THE KIDNEY: NEPHRECTOMY.

Dr. Hartwell presented a man, twenty-seven years of age, who was admitted to the Presbyterian Hospital on December 11, 1912. He had suffered from symptoms of cystitis for eleven months, and about five months ago the diagnosis of a left-sided tuberculous kidney was made, and tubercle bacilli were demonstrated in the urine. At the same time he was told that he had a tuberculous process in the apices of both lungs, and for that reason he was advised against operative interference. He grew progressively worse as far as the urinary symptoms were concerned, and on admission was suffering constantly and severely from the cystitis.

Examinations with the cystoscope and the X-ray confirmed the diagnosis of the kidney lesion, but there were no definite signs of pulmonary tuberculosis.

A nephrectomy was done on December 20, 1912, through a straight incision outside of the spinal muscles. The left kidney was found to be almost completely destroyed with tuberculosis, there being a cheesy abscess in each calyx. The ureter was found to be dilated and markedly diseased as far as it could be followed through the existing incision, a distance of five inches. It was divided at this point with the actual cautery. A large probe was passed into the bladder, insuring the patency of the ureter, and then the cauterized end was ligated with catgut. The patient's condition was such that it was thought inadvisable to submit him to the added operation of removing the entire ureter, and it was hoped that with drainage into the bladder and the absence of fresh infection from the kidney, the ureteral infection might be taken care of.

Following the operation, the patient's course was satisfactory and the wound gradually healed. The cystitis, under local treatment, improved markedly. The man left the hospital in about seven weeks, having remained a month after the operative wound healed, for the bladder treatments. It was now three months since the operation and his general condition was excellent, there having been a gain of thirty pounds in weight. The bladder condition, too, had steadily improved, and now he had almost no subjective symptoms of the cystitis excepting slight pain at the end of micturition, which was not unduly frequent. About two weeks ago, however, the wound in the back broke down and has since remained open. At the present time there is a sinus, presumably leading to the ureter, which is lined with typical appearing tuberculous granulations.

In view of his marked general improvement and the steady progress of the bladder lesion towards recovery, was it advisable to temporize in dealing with the sinus, or should the remainder of the ureter be removed at once?

ENTEROSTOMY FOR INTESTINAL OBSTRUCTION FOLLOWING ACUTE APPENDICITIS.

Dr. Hartwell presented a girl, five and a half years old, who was admitted to the Presbyterian Hospital on October 15, 1912, with a well developed appendicular abscess of five days' duration, this being her first attack. Her past history was uneventful and she had always been a child of normal intelligence and mental activity. The routine physical examinations showed nothing abnormal excepting the usual signs of an abscess in the right lower abdomen. There was no evidence of either tuberculosis or syphilis.

An immediate operation was done, and a small abscess with a chronically inflamed appendix was found. The appendix was removed, ligating and cauterizing the base, but not inverting it. A small double tube drain was placed in the abscess cavity.

On the second day following the operation the child developed signs of intestinal obstruction. This was thought to be a paralytic ileus, but it failed to respond to the usual remedies, and at the end of the third day an enterostomy was done by opening through the left pararectus line and inserting a small tube into the first presenting coil of small intestine through a small stab-wound, which was surrounded by a purse-string suture.

Following this procedure, the patient's condition was satisfactory, the intestinal drainage being free and the obstructive symptoms subsiding. Three days later, methylene blue given by the mouth did not appear in the enterostomy wound until the ninth hour; the discharge, however, was that from the upper intestine, and there was a very considerable digestion of the skin. After the seventh day the fecal discharge from the enterostomy wound grew progressively less, and there was some fæces passed per anum. Gradually this increased in amount, and the amount of discharge through the enterostomy wound became very small, so that the skin healed up and only one dry pad a day was required to keep the parts clean. The child's general condition, however, was very unsatisfactory. She ate only fairly well, and there was very rapid and severe emaciation until she appeared like a child in the advanced stage of starvation. She was very restless, irritable and mentally depressed, and after two weeks she developed a bronchopneumonia which lasted about a fortnight. Her condition was strongly suggestive of pulmonary tuberculosis, but no bacilli could be found and the signs in the lungs gradually cleared up without improvement in her general condition. Her mentality was very unsatisfactory: at times she was excessively irritable or she might lie for hours in deep apathy. The condition was somewhat suggestive of a tubercular meningitis, but thorough examination of the eye grounds, the spinal fluid and the skin reaction all yielded negative results.

On November 25, seven weeks after the enterostomy, and five weeks after the wound had almost closed, although there was always some discharge through it, the patient developed a condition resembling catalepsy; she refused to respond to questions and stared with dilated pupils, apparently taking no interest in her surroundings. This attack came on in the morning, shortly after breakfast, and at ten minutes past one in the afternoon she began to have localized convulsions of the right arm and face. The clonic spasms seemed to be of the cortical type, as they were both flexor and extensor in character. The pupils were widely dilated, immobile, with a horizontal nystagmus with the quick component to the right. There was marked twitching of the facial muscles, with winking of the lids and slight frothing at the mouth. The convulsions followed closely one after another, and were somewhat relieved by the inhalation of small amounts of chloroform. A lumbar puncture was done at 1.45 P.M., and twelve c.c. of clear fluid was withdrawn under moderate pressure, but without relief of symptoms. Dr. M. Allen Starr saw the case at 2.10 P.M., and considered the condition due to a cerebral embolism of a septic nature originating from either the appendicular abscess or the pneumonia. The convulsions lasted almost without interruption until five o'clock, and could only be controlled with chloroform. They were confined to the right side.

The child gradually recovered from the convulsions and on the following morning was again in the condition noted earlier in her illness, but with a marked increase in the mental apathy and irritability. No response could be obtained from her, and she seemed to have lost entirely her association with her surroundings. She failed to recognize her parents, and at times both they and the nurses and staff thought she was suffering from sensory blindness and deafness.

On November 30 another series of convulsions occurred, lasting one hour and confined to the left side. From this time on the child's condition was pitiable. In no way could she be aroused to take any notice of her surroundings, and at times she would suffer from violent hallucinations and cry out in fright, covering her face with her hands and pleading to be saved from imaginary injuries. She was emaciated and feeble. Her appetite was very capricious; what was eaten was apparently well digested, and practically all fecal matter was passed per anum, there being very little discharge from the enterostomy wound, though always some. Repeated examinations of the eye grounds, the spinal fluid and blood and complete physical examinations failed to show any evidence of organic lesion nor of tuberculosis or syphilis.

On December 22, the condition having continued the same, she was seen by Dr. Theodore C. Janeway, who offered the suggestion that possibly the loss of calcium salts and other nutritional disturbances due to the high enterostomy might be causing the malnutrition and the cerebral unbalance. On the following day, despite the very small discharge through the enterostomy wound and despite the wretched condition of the patient, the intestinal opening was closed. The child stood the operation well, and immediately following it the administration of calcium lactate was begun. The operative wound healed kindly, with only superficial suppuration, and the patency of the intestinal canal seemed normal. Her convalescence from that time on was perfectly satisfactory, and within two weeks she was entirely normal and rapidly gaining weight. At the present time she appears in every way like a robust child of six years, being quite up to the average both physically and mentally.

Unfortunately in this case, Dr. Hartwell said, no studies were made of the metabolism during her illness, but if the malnutrition and particularly the loss of calcium due to the high enterostomy did not bear a causal relation to the symptoms exhibited, then her improvement when these factors were corrected was a most curious coincidence. At any rate, the subject was worthy of serious experimental study.

Dr. Hartwell expressed his indebtedness to Dr. Eliot, on whose service these cases occurred, for the privilege of reporting them.

RHINOPLASTY BY FINGER.

DR. CLARENCE A. MCWILLIAMS presented a man, forty-five years old, who was admitted to the Presbyterian Hospital on September 5, 1912. Two years before, while working as a stationary engine oiler, his right arm was caught in a belt and his face was drawn in so that it was struck by the spokes of the wheel, annihilating his nose. He was taken to the Long Island City Hospital, where he spent a year and submitted to eleven operations.

When the patient was admitted to the Presbyterian Hospital, his face was entirely healed, but greatly disfigured and scarred. The nose, including its nasal and cartilaginous portions, was entirely missing, as was also the projection of the frontal bone forward. There was a single small opening into the nasal cavity, admitting a probe. The left nostril was entirely gone; its edge was attached to the bone underneath, while one-half of the right nostril remained and projected forward in a teat-like process. The defect in the soft parts extended up to within one inch of the frontal bone, and measured one inch in its transverse diameter and an inch and a half vertically. Any plastic operation to reproduce the nose in such a case necessitated the use of some bony support. Morestin had carried out a procedure of grafting a rib into the soft parts of the forehead, and then turning down a flap, containing the implanted rib, to form the nose. This did not seem advisable here because of the scars on the forehead, and the disinclination to augment the disfigurement by additional scars, and it seemed a more feasible plan to graft a finger into the defect. The man's condition was pitiable; he could get no position because of the deformity, and went around with a handkerchief tied about his face to hide his disfigurement.

The operative procedure followed by Dr. McWilliams in this case was that described by Finney and McGraw. The patient's head and shoulders were immobilized in a plaster-of-Paris splint the evening before the operation, and this splint was then cut down on one side so that it could be quickly removed in case of any accident during anæsthesia. This splint proved of great assistance in immobilizing the attached hand and arm immediately after the operation. A knife inserted into the defect separated the soft parts from the bone beneath, the incision being extended up to the frontal bone and the edges of the defect were pared all about the margins. As a graft, the left ring finger was chosen. After applying an Esmarch bandage about the arm, the nail of the left ring finger was removed and the tissues scraped away until the bone was exposed. The metacarpophalangeal articulation was then opened by a posterior longitudinal incision, the posterior extensor tendon was divided, the joint opened and the head of the metacarpal bone removed. After division of the anterior tendons and the lateral ligaments of the joint, the finger was free, but was still united to the soft parts and nourished by the uninjured digital vessels. The skin was removed from the entire circumference of the distal phalanx, and the tip of the phalanx nipped off with the rongeur. The finger was then slipped into place, the extremity of the last phalanx extending up to the frontal bone under a bridge of undivided soft parts. No suture was used to attach the phalanx to the frontal bone. A longitudinal denudation was made on each side of the second phalanx, about one-fourth of an inch wide, to which the edge of the cheek on one side was sutured and on the other that of the nostril, the defect between the cheek and nostril being filled in by the skin from the dorsal surface of the finger. The first phalanx was left unattached, as it was later to be turned backward. Interrupted silkworm sutures were used. A plaster-of-Paris splint was then applied about the head, arm and chest.

For two days after the operation the pain in the arm was severe; after that the arm, so to speak, fell asleep, and there was no further discomfort. On the fifteenth day after the operation one of the digital vessels on one side of the finger was tied under 4 per cent. novocain anæsthesia, and six days later the finger was amputated through the metacarpophalangeal articulation, using novocain locally. No attempt was made to close the proximal end of the finger at the time. Heat, in the shape of hot cloths, was applied to the finger for twenty-four hours. Subsequently there was some necrosis of the soft parts at the end of the first phalanx, but not to any great extent.

Eight days later the first phalanx was flexed to a right angle with relation to the second phalanx, and its tip was sutured in this position to the bone behind, while the soft parts covering it were also turned backward and sewn to the freshened lower border of the nasal defect. Sixteen days later it was necessary to remove the greater part of the first phalanx on account of necrosis. After this operation there was some infection of the finger, the pus from which escaped through several points in the line of the scars. This infection, however, was soon controlled. The tendons of the transplanted finger were not disturbed at any time during the various procedures, and were still in place.

At the present time, while the man is still far from handsome, his appearance is vastly improved over what it was prior to the operation. There is no evidence, now three months after the operation, of any regrowth of the nail. There was a small opening into the nasal cavity, but not sufficient for respiration.

The man was a mouth-breather and had very little sense of smell.

The wound caused by amputating the finger healed by primary union. The tip of the last phalanx seemed to be solidly united to the frontal bone. During the 21 days that the finger remained attached to the face and hand, the patient's nourishment was restricted to fluids and administered through a tube passed into the angle of the mouth. At the outset of the operation, it was planned to wait but fourteen days before amputating the finger, but at the expiration of that time the patient was so comfortable that it was deemed safer to wait another week.

ARTERIOVENOUS FEMORAL ANASTOMOSIS (LATERAL TRANSVERSE) FOR THREATENING GANGRENE.

DR. McWILLIAMS presented a man fifty-three years old, a physician, who lost the last two phalanges of the second left toe, in 1903, by gangrene. Six years ago Dr. McWilliams amputated the right leg at the junction of the upper and middle thirds for a gangrenous condition of three toes which extended up on the foot for two inches. At that time he realized the danger of the stump not healing, but decided to run the risk of doing a low amputation, in view of the fact that the man was dependent for his living on having as serviceable a limb as possible. There had never been the slightest trouble from this stump, and the left foot remained free from further disturbance until two years ago, when the stump of the second toe became painful. Subsequently, the end broke down and has remained unhealed until the present time, being covered by an indolent crust. In November, 1912, the stump of the second toe became discolored and very painful. Two months later the pain had extended to the third, fourth and big toes, which also became dusky and tender. There was also intense pain and discoloration over the instep, and considerable œdema of the foot, gradually diminishing up to the ankle-joint. Walking was impossible, and a most striking feature was the icy coldness of the extremity.

The patient entered the Presbyterian Hospital on February 10, 1913, expressing the hope that anything be done except an amputation. An end-to-end vessel anastomosis has been performed in a number of these cases, but the disadvantage of this method was that, if anything went wrong with the anastomosis, then the gangrene was made much worse. Dr. McWilliams thereupon resolved to try the lateral anastomosis, which Bernheim, of Johns Hopkins, had done eleven times with his transverse method. The speaker said he realized the possibility of an arteriovenous aneurism developing, but this had not occurred in any of Bernheim's cases.[1] It did not seem reasonable to expect that there would be any improvement in the stump of the second toe, the vessels of which were probably almost completely occluded, but it was hoped to get enough blood down to the foot to obviate the threatening gangrene in the foot and the other toes. The result of the operation entirely justified this reasoning. If amputation should later become necessary through the failure of the anastomosis, then it was hoped that enough blood would get down into the leg to assure the success of the amputation. The fact should not be lost sight of that the arterial blood also has to overcome the valves in the veins.

On Feburary 11, 1913, Dr. McWilliams anastomosed the femoral artery and vein laterally, according to Bernheim's method, making a transverse incision with a small cataract knife through one-third the diameter of the artery. The anastomosis was made three inches below Poupart's ligament, just underneath a visible valve in the vein, the artery being situated in front of the vein. Four Crile carotid artery forceps were first applied, above and below the orifice. The opening in the vessels, by the action of their longitudinal fibres, at once became oval. The walls of the artery were twice their normal thickness, and its lumen was small. The contained blood was immediately washed out with salt solution, and liquid vaseline was smeared inside and outside their lumina. An oiled, continuous, fine silk suture was then passed, with the knots outside, uniting the edges. The vein was ligated permanently, proximal to the anastomosis. After removal of the Crile clamps there was no leakage. The pulsations were seen and felt to go down the vein as far as the latter could be followed in the incision. The wound healed primarily.

For five days after operation the pain was agonizing, requiring the use of considerable morphia. The most striking change noted was in the temperature of the foot, which became normally warm. The patient was kept in bed for fourteen days.

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[1] Bernheim: Jour. of the American Med. Ass'n., Feb. 1, 1913, page 360. ANNALS OF SURGERY, Nov., 1912; also Feb., 1912.

and left the hospital on March 1, 1913. By that time the œdema had entirely disappeared and thus far it has not returned, even after walking. There was also a disappearance of the tenderness and pain in all of the toes, save in the stump of the second toe, which has remained tender and painful. There is now no popliteal pulsation to be felt. Over the site of the anastomosis one can hear a thrill with the stethoscope.

In connection with this case, Dr. McWilliams raised the query whether it would be advisable to remove the stump of the second toe. Would the wound heal or not? In cases of threatening gangrene the method seemed worthy of trial, but where gangrene had already set in to any degree, it was useless to do it, for the vessels were impervious. It might, however, permit one to do a lower amputation than was usual.

As to end-to-end *versus* lateral anastomosis, the speaker added that Wieting, of Constantinople, who had done considerable work in this field, had come to the conclusion that a lateral anastomosis ought to be the method of choice, and he himself now restricted himself to that method.

ILEUS FOLLOWING GANGRENOUS APPENDICITIS WITH GENERAL PERITONITIS.

Dr. McWilliams presented a boy, thirteen years old, who was admitted to the Presbyterian Hospital, in the service of Dr. George Woolsey, on August 16, 1912. A median suprapubic incision was made by Dr. Woolsey, the appendix was removed, a large amount of free pus evacuated, and two cigarette drains introduced into the right flank. The operation was followed by excessive distention of the abdomen, which was unrelieved by enemata, and three days later Dr. McWilliams punctured the cæcum in the wound. This afforded great relief, and the peritoneal irritation soon subsided. On the fifteenth day the boy awoke with pain in the left abdomen; he vomited and there was again marked abdominal distention which could not be relieved by enema. His pulse, which had been practically normal, went up to 120, and on the following afternoon he had two convulsions.

Operation by Dr. McWilliams, eighteen hours after the onset of the pain: On account of the fulness in the left iliac fossa, an incision was made through the left rectus. Numerous adhesions between the intestines were encountered, with several collapsed coils of gut in the right pelvis. Upon following these up, he came upon a band encircling the gut, which was dilated proximally. Upon separating the adhesions, gas was observed to enter the collapsed gut. The wound was thereupon closed, and, at the completion of the operation, fæces were passed through the colostomy opening.

Following this operation, all the patient's symptoms subsided. Within a few days fæces were passed per rectum as well as through the colostomy wound, which showed no inclination to close. The fecal discharge through this wound produced severe irritation of the adjacent skin, and the boy was losing weight. A month later Dr. McWilliams tried to close the fistula by dissecting it free and inserting a double row of Lembert sutures: these failed to hold and the condition was as bad as ever. Two weeks later he did a more radical operation, dissecting out the fistula and putting in three rows of Lembert sutures. These evidently puckered the intestine too much, as their insertion was followed by pain, vomiting and distention, and no movement of the bowels. Two days later he punctured the intestine in the wound and after two weeks he did a final operation, opening the right rectus above the cæcostomy opening and anastomosing the small intestine (just proximal to where it entered into the mass of adhesions in the right iliac fossa) to the transverse colon by means of a Murphy button placed in the sides of the two coils. To insure union a continuous silk suture was inserted around the button. No drainage. Following this there were no further unfavorable symptoms, and the fistula permanently closed at once. The case illustrates the value of an artificial anus in presence of paralysis of the bowel from sepsis, and also the difficulty which may be met with in closing it. Probably in the majority of cases the anus will close of itself.

PYLOROPLASTY FOR PERFORATING DUODENAL ULCER.

Dr. A. V. S. Lambert presented a man, thirty-five years old, a letter carrier, who gave a history of stomach trouble dating back for five years, and characterized chiefly by epigastric pain and distress and eructations of gas coming on an hour or two after eating. Four hours before his admission to the Presbyterian Hospital he had a severe, sharp, lancinating pain in the epigastrium while he was making his rounds delivering mail. He had taken no food for several hours previous.

At the time of his admission, he complained of intense abdominal pain. Examination showed retraction and pronounced rigidity of the abdomen, more or less generalized. His general condition was excellent; his temperature was normal; there was no leucocytosis. At operation an ulcer was found about a quarter of an inch beyond the pyloric vein on the anterior surface of the duodenum. This was punched out and was surrounded by a moderate amount of induration. The ulcer was excised, and a pyloroplasty, as described by Finney, was done.

For 48 hours following the operation the patient vomited considerably, and his stomach was washed out every twelve hours. The contents of the stomach were dark brown. A diastasis of the upper recti developed, and a secondary closure of the wound was done on the fourteenth day. His further recovery was uneventful and he has been free from symptoms since.

ŒSOPHAGO-GASTROSTOMY FOR CARDIOSPASM.

Dr. Lambert presented a woman, forty years old, who was admitted to the medical division of the Presbyterian Hospital on April 10, 1912, with the diagnosis of carcinoma of the stomach and a history of persistent vomiting and progressive and marked loss of weight. The vomitus consisted of the food just taken, unchanged. A test meal showed 190 c.c. of thick fluid, with mucus, acid in reaction. No free hydrochloric acid; considerable lactic acid and some blood, with many bacilli resembling the Boas-Opler bacillus.

The patient was transferred to the surgical division on April 16 and an exploratory laparotomy was done, which showed that the stomach was normal. The appendix was removed. Following this operation there was no abatement of the symptoms. and ten days later the patient was sent back to the medical ward, where on May 1 the diagnosis of a dilated œsophagus with cardiospasm was made with the X-ray after the ingestion of bismuth. She was again sent to the surgical division, and as her weight had fallen to 74 pounds a gastrostomy under cocaine anæsthesia was done. Frequent attempts were made to have the patient swallow a string, but these were all unsuccessful. Dr. Stevens finally succeeded in passing a string upward through the cardia via, the gastrostomy opening, by means of a cystoscope, and Dr. H. H. Janeway, with the aid of the œsophagoscope, drew this string upward out through the mouth. Plummer apparatus was then readily passed through the cardia which was dilated, but without resulting benefit. This failure to give the patient relief from dilatation was believed to be due to the course of the œsophagus, lying as it did on the surface of the diaphragm, and the point of its entrance through the diaphragm being situated above the lowest part of the pouch.

On February 1, 1913, an œsophago-gastrostomy was done. An L-shaped incision was made in the median line, with extension to the tip of the tenth rib. Through an incision over the seventh rib beneath the breast the seventh, eighth and ninth ribs were fractured, and a flap turned backward and upward. The left broad ligament of the liver was divided, and the gastrostomy opening separated from the anterior abdominal wall. The stomach and spleen were then dragged downward which gave a ready access to the cardia. The diaphragm was divided to the left of the œsophagus; the left pleura, which was accidentally nicked at this point, was closed by suture. The œsophagus was then loosened from its attachments to the pericardium, diaphragm and aorta, and the findings of the X-ray examination confirmed by palpation. A stiff bougie was then passed down the œsophagus and impinged against the diaphragm, well to the right and posterior to the point where the œsophagus passed through the diaphragm. The portion of the œsophagus situated below the lower end of the bougie was then pulled into the abdomen, and the diaphragm was sutured to the œsophagus at the point where the bougie was intercepted. A large clamp was then passed into the stomach through the gastrostomy opening; one blade of this was passed into the œsophagus through the cardiac opening while the other blade remained in the stomach in such a manner that, when the clamp was closed, there was included between its two blades a portion of œsophagus and a portion of the greater curvature of the stomach or cardia. A few interrupted sutures approximated the œsophagus and stomach about the closed clamp. A rubber tube drain was inserted alongside of the anastomosis. The gastrostomy opening was brought to the abdominal wall and the clamp was left *in situ*.

During the first ten days of the patient's convalescence she had a left-sided pleurisy. The clamp was tightened on the fourth day, and removed on the eighth day. The patient was given liquid food by the mouth for 28 days, when the tube was left out of the gastrostomy. She was able to take solid food by the mouth on the 33d day. She had lost some weight after the operation, which she has since regained. There was occasional regurgitation of food, but this is becoming less frequent.

Dr. Willy Meyer said there were a certain number of cases of cardiospasm that were intractable and did not yield to stretching, and demanded operative interference. The case shown by Dr. Lambert was interesting in that the obstruction was attacked from below and that sufficient space was obtained to do an anastomosis. Dr. Meyer said it had been his good—or bad—fortune to meet with three of these cases within the past few years. In one of these, a woman, where it was found impossible to enter the cardia and dilate the œsophagus, he did a thoracotomy and after loosening the pouch he made a double plication of its anterior wall. The patient made a good convalescence and spontaneously regained the ability of swallowing fluids and later solids. Subsequently, she developed, after an acute pneumonia, an œsophageal fistula in the thoracotomy scar, and finally died from an infection of the posterior mediastinum. She had no difficulty in swallowing up to the end. In the second case practically the same method was followed, but a single plication made. In the third case there was a slight stricture of the cardia, most likely following a peptic ulcer.

In the second case the first operation was followed by only temporary improvement, and six weeks ago Dr. Meyer did a second thoracotomy, cutting out a large aperture in the chest wall in order to gain access to the part. Dense adhesions in the posterior mediastinum prevented a good exposure of the œsophagus. The œsophageal foramen of the diaphragm was incised and an intrathoracic cardioplasty done, after the method of Heinicke-Mikulicz at the pylorus. The patient made a good recovery and his ability to swallow was much better than it was before the operation. The speaker said he did not know whether the case would go on to complete recovery, but the point he wished to emphasize was that we could treat the cardia in much the same way as we could the pylorus. The approach to the cardia was certainly easier through the thorax than through the abdomen.

Dr. Lambert, in closing, said the clamp was chosen in this case because it seemed to offer the better safeguard to preventing the contents of the œsophagus from entering the pleural cavity and the mediastinum. The cavity produced by the dilated œsophagus always contained very foul-smelling material, and it was thought that if the anastomosis could be made from the abdomen, the clamp would serve its purpose until adhesions had formed. The rather adverse reports that had followed the intrathoracic method in operating on these cases had decided them to go in from below.

SACROCOCCYGEAL CYST.

Dr. George Woolsey presented an infant, who, when admitted to the hospital, in May, 1912, was nine days old. The mother stated that five months before giving birth to the child she had received a blow over the abdomen, which apparently gave rise to no symptoms. The labor was normal, the child was put to the breast and for the first three days it nursed well and was free from symptoms. Then vomiting set in and became almost constant.

When Dr. Woolsey first saw the child, six or seven days after birth, there was a swelling in the sacrococcygeal region, which pushed the scrotum and anus forward and pressed against the subpubic arch. The swelling was apparently a cyst, and upon aspiration, a clear, yellow fluid was withdrawn. Two days later the legs and lower abdomen became swollen. The cyst was again aspirated and four ounces of fluid withdrawn, but this produced no effect on the swollen parts, which became cyanotic. The vomiting still persisted; the bowels were obturated and the child was unable to void urine.

Operation, May 9, 1912: Upon incising the cyst, several smaller cysts were found to project into it from the deeper surface. The largest of these extended upward into the abdominal cavity between the rectum and sacrum, pressing on the iliac veins. About eight ounces of fluid were withdrawn, and part of the redundant outer wall of the cyst resected. Following this operation, the venous congestion and swelling of the legs and abdomen immediately disappeared, and the child was able to void urine and defecate. The vomiting also ceased. The child's convalescence was practically uneventful, and it was discharged on May 17, 1912. Up to the present time, there had been no recurrence of the cyst. There was some redundance of the skin over the buttocks, which was much scarred by stitch abscesses. Since the operation, the child had grown remarkably well.

BILATERAL CALCULOUS PYONEPHROSIS.

Dr. Woolsey presented a woman who had already been shown by him at a meeting of the Society on November 22, 1911 (Annals of Surgery, vol. lv, page 450). She was forty-nine years old at the time when she was admitted to the Presbyterian Hospital on July 17, 1911. She then gave a history of having had mild attacks of pain in the right kidney region for twenty years prior to March, 1896, when she was operated on at Bellevue Hospital, where three stones, including a large, pipe-stemmed one, were removed from the right kidney. The kidney consisted of a thick shell, containing several large pus pockets. Her pain persisted, and an X-ray showed stones in both kidneys. A right nephrectomy was planned, but a ureteral catheterization showed that the right kidney was apparently the better of the two. In November, 1906, the patient was again operated on, this time at the Presbyterian Hospital, where one stone, the size of an olive pit, and several smaller ones were removed from the right kidney. At this time two small pockets of pus were opened, and the kidney was drained. On the 6th of the following month the left kidney was opened, and three or four calculi removed. This kidney was found to be much enlarged and adherent, and filled with pockets of thick, greenish-yellow, foul-smelling pus. After this operation a sinus persisted for nearly a year. The wound on the right side had healed rapidly, and the patient gradually gained in strength.

After the above operations the patient had occasional slight attacks of pain in the right lumbar region, and eight days prior to her readmission to the hospital she was seized with a sharp, severe pain over the old wound on the left side, followed by the appearance of a hard but not very tender mass. On the day of her admission this swelling broke and, with the spontaneous evacuation of a large quantity of greenish pus, her pain ceased. An X-ray showed stones in both kidneys, more pronounced on the left side, and there was also a stone in the left ureter at the brim of the pelvis. In the middle of the left lumbar scar there was a small sinus discharging yellow pus, without urinous odor. On bilateral examination a mass twice the size of the kidney was felt in the left upper quadrant; it could be pushed forward from behind, was firm and smooth and not very tender.

On July 28, 1911, Dr. Woolsey opened the old scar, evacuating three pockets of pus and partly freeing the kidney from adhesions, but these were so dense that he was unable to deliver it into the wound. The kidney was thereupon incised, and with some difficulty several phosphatic stones were removed, one the size of a robin's egg, and two of bean size. The abscess seemed to be outside of the kidney, which was very much altered, and reduced to a thick shell. The wound was closed, with drainage.

The patient made a good recovery. The amount of pus in the urine gradually decreased, and under the use of urotropin the reaction of the urine first became neutral and then acid. The wound was closing well and draining considerable urine, and the patient was able to leave for home on August 11, 1911. At the time it was planned to remove the ureteral calculous at some future date, if necessary.

The patient was readmitted to the hospital on February 26, 1912, and two days later Dr. Woolsey exposed the left ureter, which was enlarged to the size of an adult's thumb, with thickened walls. Midway between the pelvic brim and the bladder there was a dark, rough, flattened stone, about one cm. long, which was removed, and two inches below the kidney pelvis two smaller stones were encountered and removed through separate incisions, which were closed by suture. On April 10, 1912, an abscess, about the size of an orange, in the upper pole of the right kidney, was incised and drained.

At the present time (March, 1913), the patient states that she has not felt so well for ten years. Two sinuses persist in the left lumbar scar. One of these, apparently, was kept open by a fragment of rubber tubing which was removed five days ago under local anæsthesia.

This patient, Dr. Woolsey said, was presented again at this time as an example of subjective good health in spite of two greatly damaged kidneys, either one of which would naturally have been removed as useless. The X-ray showed no stones in the kidneys or ureters, for the first time in years.

SPLENECTOMY FOR BANTI'S DISEASE.

Dr. Joseph A. Blake presented a woman, forty-five years old, born in Russia, and a housewife by occupation. The history she gave was that three years ago she had a pain in her upper left abdomen. This was sudden in onset and sharp, lancinating in character. It persisted about a month and confined her to bed for three weeks. She then remained free from pain until about one year ago, when it recurred in the same location, but this time it assumed more of a dragging character and extended to the left side of the back and the left lower extremity. She had occasional attacks of vomiting, and the pain had persisted, more or less, up to the present time. Three weeks ago, following a heavy meal, she had a sudden attack of faintness; she was hungry for air and looked very pale. Following this attack she vomited three times in the course of two hours, and on one of these occasions the vomitus was very profuse and contained much clotted and fluid blood. For a day or two after this attack she passed dark material (blood?) in her stools. There was no further history of hæmatemesis or melæna. During the past few years she had gradually lost flesh and strength, her weight having decreased perhaps 40 pounds. The patient gave no alcoholic history. Her appetite was good; the bowels regular; no diarrhœa. She had been married for 26 years and was the mother of four healthy children. No miscarriages.

Upon admission to the hospital, the patient was thin and sallow. The superficial lymph nodes were not enlarged. The abdomen was full and rounded, and moved easily with respiration. There were no enlarged veins; no peristalsis. The spleen could be felt one inch to the right of the midline and one inch below the umbilicus, and its edge could be felt indefinitely in the posterior axillary line. Its surface was smooth; there was no tenderness nor rigidity.

An examination of the blood gave 2,060,000 red blood cells, 5,800 white blood cells, 58 per cent. of polynuclears and 45 per cent. of hæmoglobin. The stools were examined repeatedly for occult blood, with negative results. On the 28th day after admission an examination of the blood showed 2,800,000 red blood cells, with 65 per cent. of hæmoglobin. During this time the patient had a slight temperature, varying from 99° to 100°, and she had had one attack of pain in the left upper quadrant, of several hours' duration. There was no resistance nor rigidity.

The case was regarded as one of splenic anæmia, and a splenectomy was done on the 29th day after admission. The spleen was found to be of immense size and attached to the posterior and lateral abdominal walls and to the diaphragm by many vascular adhesions. There were numerous tortuous veins in the splenic pedicle. No thrombo-arteritis was made out. The hemorrhage during the operation was severe.

On the day following the operation the blood showed 2,450,000 red blood cells, 24,000 leucocytes, 79 per cent. of polynuclears and 50 per cent. of hæmoglobin. The temperature, which had gone up to 103°, gradually fell to 100°. There was considerable pink oozing through the stab-wound drain. The pulse ranged between 115 and 130. The patient's convalescence was slow, but gradual, and on the 35th day after the operation a blood count showed 3,200,000 red blood cells, 16,000 leucocytes, 74 per cent. of polynuclears and 65 per cent. of hæmoglobin. Her general condition was improved, and there was less abdominal pain each day. She was able to take a little exercise and expected to go to the country.

The spleen, when removed, measured 21 x 18 x 8 cm. Its contour was preserved, its surface being covered in places by organized adhesions. Microscopically, its capsule was found to be thickened, there was an increase in the connective tissue framework, with a marked decrease in the Malpigian bodies. The splenic pulp showed a marked increase in connective tissue reticulum caused by the flushing out of the spleen after its removal. The sinuses appeared empty. There were no evidences of multinuclear cells or epithelioid cells. Section through the splenic artery showed definite thickening of the media; the vein was normal. Diagnosis: Splenic anæmia; perisplenitis.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY.

Stated Meeting held March 3, 1913.

Dr. Gwilym G. Davis, President, in the Chair.

TOTAL EXTIRPATION OF THE EXTERNAL GENITALIA FOR CARCINOMA.

Dr. E. Hollingsworth Siter presented a patient in whom a total extirpation of the external genitalia for carcinoma had been done.

SUBDIAPHRAGMATIC ABSCESS.

Dr. Duncan L. Despard read a paper with the above title, for which see page 334.

Dr. John H. Jopson said that it had been his misfortune to see a good many cases of subphrenic infection, including cases following appendicitis, ruptured gastric and duodenal ulcers, operation for cholecystitis, and one case of probable kidney infection,—12 cases in all, with a mortality of 58 per cent.

Appendicitis is probably the most frequent cause of subphrenic infection in this country, although it frequently follows the accident of perforating gastric or duodenal ulcer. Appendicitis is easily the most frequent cause in children, as was shown in his study of all the reported cases up to 1903.

Some distinction should be made between subhepatic and subphrenic abscesses, because the symptoms of the latter are often more characteristic. Several times in subphrenic infection he had found an early inflammation of the pleura present, as shown by pleuritic pain, friction rub, fine râles and an early involvement of the lung. In many cases of true subphrenic abscess, however, these symptoms are transient or absent, as are nearly all of the classical symptoms detailed by Dr. Despard. A persistently high temperature and the physical signs of a collection, large or small, usually on the right side, are sometimes the only symptoms present. In one young child under his care rapid emaciation was a striking symptom. In some cases physical signs suggesting subphrenic abscess are apparently present and no abscess exists. A few weeks ago there was such a case at the Presbyterian Hospital which was studied very carefully by both the medical and surgical men and also by the radiographer. All signs pointed to a pleural effusion. The patient had had perforative appendicitis followed by high fever, and all agreed upon a probable diagnosis of subphrenic abscess. Aspiration and subsequent abdominal exploration were both negative and proved this diagnosis to be wrong.

In another case in which the patient was demonstrated at operation to have a large collection of pus in the subphrenic region an X-ray was taken before the operation, and the radiographer denied the possibility of a subphrenic collection, but after operation, acknowledged that he had failed to read his plate correctly. We must, therefore, acknowledge that X-ray pictures in this condition require very careful study and expert interpretation, and even then, may be deceptive; but they should be taken in all suspected cases, as they will in time undoubtedly furnish us valuable information as to the presence of such collections.

Dr. George G. Ross said that it had been his experience that subdiaphragmatic abscess is due more often to inflammations of the vermiform appendix. He remembered one case due to perforative gastric ulcer which was of the anterior subdiaphragmatic variety. He thought the appendix gives rise more often to infection of the subhepatic space, but when it occupies a position behind the cæcum the direct line of infection is toward the subdiaphragmatic space, largely on account of the arrangement of the psoas-iliacus muscle which gives a distinct upward flow to the infection when the patient is recumbent. His attention was called to this subject by an occurrence at the German Hospital in which in one week there were four cases of subdiaphragmatic abscess in patients operated on for appendicitis.

Dr. Astley P. C. Ashhurst said that he had gone carefully over the case reports, and found that only an exceedingly small number were what should be called true subphrenic abscesses; the vast majority were what are properly described as subhepatic abscesses or abscesses of the kidney pouch. The incision in these cases was made over the appendix, and whenever pus was found running up toward the liver the case was classed as one of subphrenic abscess. It is correct to distinguish between these cases and those of true subphrenic abscess. If he were to add to his relatively small number of subphrenic abscesses the large number of cases of appendicitis in which at operation he had found pus extending up toward the liver he should have a very large number of subphrenic abscesses with a very low mortality, instead of a few cases with about the average mortality.

A subphrenic abscess in the left region of the diaphragm he had seen only in one case of a child of two years, at the Children's Hospital in the service of Dr. Hutchinson, in 1906: this apparently was the result of tuberculous peritonitis. The abscess had discharged at the umbilicus before the child was admitted to the hospital; with Dr. Jopson's assistance he explored the sinus, but a fecal fistula developed within a week, and the child died about a month later.

As to pleural effusion as a valuable sign in the diagnosis of subphrenic abscess, a patient with stab-wounds of the liver on whom he operated last year for Dr. Frazier at the Episcopal Hospital developed thoracic signs during convalescence; but although his chest was tapped on several occasions at the point indicated by the consultant (Dr. Geo. W. Norris) no fluid was found at any time, nor did he have any other evidence of subphrenic or hepatic abscess. He carried a septic temperature for a long time, and all the physical signs of pleural effusion were present, but he finally recovered.

Dr. Despard has spoken of the danger of infecting the pleura in doing a transpleural operation for drainage of a subphrenic abscess, and while no doubt this danger is greater in cases of subphrenic abscess than in cases of hepatic abscess yet if the technic is proper the danger he believed was overestimated. Dr. W. W. Ashhurst had a large experience in these operations when he lived in Mexico, and devised the following technic: after subperiosteal excision of the rib selected, a curved needle is passed through both layers of the pleura in the costo-phrenic sinus and is made to penetrate the diaphragm; the fact of penetration is ascertained easily by the sensation when the needle catches in the diaphragm. A row of such sutures is inserted along the upper margin of the space left by excision of the rib, and not until the intact pleural cavity is in this way isolated from the operative field are the deep layer of the periosteum, the contiguous layers of the pleura and the diaphragm incised. In this way the chance of infecting the pleura is very remote.

Dr. Despard remarked, in closing the discussion, that the belief that subdiaphragmatic abscesses are more usually due to the appendix, is true if only applicable to the subhepatic fossæ, but if all the subdiaphragmatic areas are considered statistics will show that perforating ulcers of the stomach or duodenum are the most frequent cause. The subhepatic fossa is the site of an abscess truly subdiaphragmatic for it rests upon the right crus of the diaphragm and is limited above by the right lateral ligament of the diaphragm.

In regard to the case spoken of as not having been drained, the evidence of infection in this region at the time was not sufficient to justify drainage. At the autopsy this abscess was found to be both intra- and extraperitoneal, involving the upper pole of the right kidney and the under surface of the liver. It was probably imperfectly drained through the anterior wound, so that the pus did not accumulate in sufficient quantities to give such definite physical signs as would justify exploration.

How this extended to the point above the kidney is uncertain, but probably by means of the retroperitoneal lymphatics. He suggested this differential point, lumbar or postcæcal abscesses are entirely different from subdiaphragmatic abscesses and are often due to imperfectly drained appendiceal infections; none of his cases were of this variety or in this situation.

TUMORS OF THE CAROTID BODY.

Dr. John Chalmers DaCosta presented a specimen of a carotid tumor which he removed several months ago. The patient was a woman of thirty-six years of age. The growth began 16 years ago, was very slow for many years but during the last 6 months it has grown more than it did in the previous 15½ years. The tumor is about the size of an English walnut. The diagnosis was made in this case before operation. The very slow growth for years, the carotid pulsation which lifted the tumor at every beat of the artery, the absence of expansile pulsation, the free movement from side to side, the absence of mobility from above downward and from below upward indicated a tumor of the carotid gland.

A few years ago he made a report of a case of tumor of the carotid gland upon which he had operated. In that case he was obliged to tie the common carotid artery and as a result of the ligation hemiplegia developed. He stated on that occasion that he would never again remove one of these growths, a statement which is proof of the truth of the saying of James Russell Lowell, that "one should not prophesy unless one knows!" In spite of that prophecy he now reported another case. There are very few cases of carotid tumor on record, 32 altogether. The mortality has been 25 per cent. and in 6 of the cases there was recurrence. In several of the more recent cases it was found possible to remove the growth without tying the common carotid.

Again, these growths when they begin to show rapid enlargement have become malignant and if let alone will produce death. He determined to operate on this patient and succeeded in getting the gland out of the carotid bifurcation without tying the common carotid, although he was forced to tie the external carotid. The pathological report shows that the growth is a perithelioma.

MYXOCHONDRO-ENDOTHELIOMA OF OCCIPITAL BONE.

Dr. Da Costa presented an enormous tumor which he had removed from the nasopharynx of a colored woman aged twenty-four years. The pathological report shows it to be a myxochondro-endothelioma. It was so large that it filled the entire back of the throat and between it and the dorsum of the tongue it was not possible to pass the handle of a spoon laid flat. The woman was in immediate peril of suffocation. This growth had lasted for 6 years. He performed a preliminary tracheotomy and a few days afterward tied each external carotid artery and explored to see if he could possibly remove the growth without serious mutilation of the patient. It was necessary to remove the right half of the upper jaw, because the growth had invaded the posterior part of the antrum. The growth sprang from the basilar process of the occipital bone and had fused with the palate bone, the soft palate and a part of the superior maxillary bone on the right side. The removal was accomplished with difficulty and in spite of the carotid ligation occasioned severe hemorrhage.

LACTEAL CYST OF BREAST.

Dr. Da Costa presented a specimen being a huge milk cyst of the breast. He said that it was the second one he had ever seen. The previous one, which was much smaller, was in the service of Professor Keen. This growth did not start during pregnancy nor lactation, at least if it did the woman never noticed it, but it began six years after a child birth. It grew slowly, was free from pain, troubled her only from its weight, and felt soft, as though it ought to fluctuate, but there was no fluctuation. As one pressed upon it it suggested thick walls with fluid beyond them. There were many large veins in the skin of the breast. There was no discharge from the nipple and there never had been.

On opening into this it was found that the entire breast was converted into a grayish yellow mass of the consistency of butter. Macroscopically there was no breast tissue remaining. Therefore, he removed the gland. Chemical tests showed that it contained products from milk and a study of it proved it to be a typical galactocele, the breast being practically completely destroyed.

ACUTE SPONTANEOUS PERFORATION OF THE GALL-BLADDER INTO THE FREE PERITONEAL CAVITY

Dr. George G. Ross reported the history of a case of perforation of the gall-bladder into the free peritoneal cavity due to ulceration of the gall-bladder walls, as follows: Woman, age sixty-three years. In childhood had measles. At thirty-three years of age had catarrh of the bowels, during and immediately following which she had malaria which lasted one year. During malarial influence she had a chill every other day but did not go to bed. About this time (33rd year) she had indigestion so bad that she ate only " starch " and " camphor," eating about a pound of washing starch daily and now and then camphor.

In April, 1912, she was suddenly seized with a severe pain in the epigastrium which lasted about one day leaving her tender and sore for one week afterwards. On May 13, 1912, there was another attack of very severe and excruciating pain in the lower abdomen. Three days prior to May 13 she had complained of marked abdominal soreness, but the sudden pain on May 13 seemed to be a climax. This pain was accompanied by nausea and vomiting, constipation and a diminished amount of urine. This lasted until Wednesday, May 15.

Monday, May 13, the temperature was 99 degrees, pulse 84 and respiration 12. The very slow respirations were said to be due to morphin sulphate. As time went on from Monday, May 13, to Wednesday, May 15, the abdomen continued to become more and more distended and the urine smaller in amount and of redder discoloration. Tuesday, May 14, during the morning she again had a very sudden, severe and excruciating pain in the lower abdomen which also radiated to the shoulder and back. Wednesday morning, May 15, the abdomen became greatly distended and was quite tender and sore and more or less painful, but the pain was not so severe as during the previous few days. There were no peristaltic sounds audible. The urine was diminished in amount. The bowels had not moved and she had not passed flatus.

Operation, May 15, 1912. An incision was made in the right upper rectus close to the semilunar line. On opening the peritoneum the abdominal cavity was found to contain free fluid, of the appearance and nature of bile. The "bile" spurted from the wound on incising the peritoneum. In the pelvis was found a cloudy, bile-stained fluid. The gall-bladder was perforated and had discharged its bile content and 10 or 12 stones into the abdominal cavity. About 250 gall-stones of greatly varied sizes, the majority of which were small, split-pea size and the largest of which was about 1.50 x 2.00 x 0.75 cm., were removed from the gall-bladder. The gall-bladder "rupture" occurred on the inferior surface near the cystic duct. The gall-bladder mucosa was inflamed and the wall thickened. There were fine adhesions in many places. The bile ducts were patulous. A rubber drainage tube was sutured to the gall-bladder wall entering the bladder. There was no attempt made to sew up the rent in the gall-bladder. A small puncture was made in the hypogastrium and a rubber catheter inserted into the pelvic cavity, for drainage purposes. The peritoneal cavity was not washed out, the excess of bile being mopped out with gauze sponges.

May 15. White blood cells 10,000.

May 22. Culture of fluid from ruptured gall-bladder showed staphylococcus and streptococcus and bacillus coli

It is quite evident that the organism found in the gall-bladder and peritoneal cavity were of a low state of virulence as the peritonitis was of a distinctly low grade, there being little or no lymph deposit and the cloudy, bile-stained fluid found in the pelvic cavity was not true pus.

Patient made an uneventful recovery, going home with a small fistulous tract to the gall-bladder.

Since preparing the report of the above case a second case was admitted to the Germantown Hospital, which Dr. Ross saw in consultation with Dr. Wm. N. Johnson to whose ward the patient was admitted.

The patient was a man, forty-seven years of age who three days before admission was seized with pain in the lower right side of the chest. This pain was made worse by a cough, which was dry, and unproductive, or by deep inspiration. For five days before this severe pain in side, patient had been coming to the medical dispensary complaining of a feeling of weakness—general vague pains, headaches, constipation, loss of appetite and restlessness at nights. Gives no history of nausea, vomiting or chills.

When admitted the abdominal wall was rigid. The distention was marked. The abdomen was so tender that palpation was painful (the weight of an ice water bag causes pain to be increased). Lower liver margin could not be felt. At a point over the gall-bladder area the tenderness was more pronounced.

The patient died the second day after being in the ward. The following are the notes taken from the autopsy report:

" Lungs, heart and pleura normal; abdominal cavity contains a large quantity of free, greenish pus; intestines distended, highly inflamed and covered with exudate; omentum matted together in the region of the pylorus and gall-bladder; gall-bladder contains a few ounces of pus; a large gall-stone found in the cystic duct; perforation (ulcerated through) in cystic duct through which pass bile and pus; dome of the liver up as high as the third rib; pancreas, spleen, kidneys and appendix normal."

Dr. John H. Gibbon asked what are the causes of rupture of the gall-bladder outside of ulceration from stone and traumatism. He had had such a case and had no idea what caused it; he expected to find a stone but on opening the abdomen there was a lot of free bile in the peritoneal cavity and the gall-bladder was full of bile. The head of the pancreas was quite hard; there was no stone. There was no difficulty in examining the pancreas, the ducts or the duodenum; and the patient was made quite comfortable by drainage. The gall-bladder was red and inflamed but there was no pus, just bile, which was seeping from the gall-bladder wall.

Dr. Astley P. C. Ashhurst called attention to the question of biliary peritonitis without perforation of the bile-ducts, and referred to the cases reported in 1906 to this Academy, in which was found bile-stained peritoneal effusion without any apparent cause. In one case the appendix was removed and the patient got well; in another simple drainage was employed and the patient died. In the first case the yellow color of the effusion was shown on examination not to be due to bile, but to " disorganization of the coloring matter of the blood." Recently he had seen an article on biliary peritonitis without perforation of the bile-tract, putting on record several cases in which operation was done. In one case, just as in the case which Dr. Gibbon has mentioned, the bile could be seen oozing through the walls of the gall-bladder even after they had been wiped dry. In none of these cases was the fluid examined to see whether it was really bile, but it may be presumed that it was in Dr. Gibbon's case, and in the similar case where it was seen oozing through the walls of the gall-bladder. In the case reported by Clairmont and Haberer (*Mitth. a. d. Grenz. d. Med. u. Chir.*, 1910, xxii, 154) the common duct was obstructed by stone, but the gall-bladder appeared healthy. These observers made a number of experiments on dogs for another purpose, but involving obstruction of the choledochus, and found in a small proportion of cases, in 3 cases out of a large number of experiments, that peritonitis occurred with bile-stained effusion, but without perforation of the bile-tract. Other cases encountered at operation have been reported by Schievelbein, by Johansson, and by Wolff. It has been suggested by Schievelbein that this filtration of bile may be due to the presence in the gall-bladder of structures known as " Luschka's Gänge." These are mucous canals extending to the subserous tissue of the gall-bladder, and are said to exist only in about 3 per cent. of cases. Schievelbein claims that inflammatory changes in the gall-bladder wall destroy its permeability. It is, therefore, only when the unusual coincidence arises (1) that these canals are present; (2) that acute obstruction occurs in the presence of a nearly normal gall-bladder, that biliary peritonitis can occur without perforation of the bile-tract. This theory, however, fails to explain cases like those reported by Dr. Davis, where the fluid was shown not to be bile, but altered blood.

While the post-mortem discoloration of neighboring parts by the bile is well recognized, it does not facilitate the explanation of such a change during life.

DR. GWILYM G. DAVIS said that the cases reported by him some years ago in the ANNALS OF SURGERY were carefully studied and the liquid was examined; the coloring matter was found to be hemoglobin.

DR. JOHN H. JOPSON said that he had operated on two cases of perforation of the gall-bladder into the general peritoneal cavity. One of these which was reported before the Academy of Surgery in 1904 was in a woman of fifty-one, sick for 48 hours with gall-stone colic, but the perforation was probably not over 6 or 8 hours duration. There was a single stone in the first portion of the cystic duct, and the site of perforation, while not determined exactly, was near the cystic duct. This patient recovered.

In the second case which was in an elderly woman the perforation was of much longer duration, probably 36 hours or longer; the patient came to operation in bad shape suffering from sepsis and exhaustion and afterward succumbed.

THE RELATIONSHIP BETWEEN GASTRIC AND PANCREATIC CARCINOMA.

DR. EDWARD A. SCHUMANN read a paper with the above title for which see page 326.

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